भारतीय मानक
Indian Standard

IS 4591 (Part 1/Sec 1) : 2020

स्वचालित सीढ़ियाँ और चलपथ

भाग 1 / अनुभाग 1 सुरक्षा अपेक्षाएँ

(पहला पुनरीक्षण)

Escalators and Moving Walks

Part 1 / Section 1 Safety Requirements

(First Revision)

ICS 91.140.90

© BIS 2020

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

December 2020 **Price Group 11**

Lifts and Escalators Sectional Committee, ETD 25

FOREWORD

This Indian Standard (Part 1/Sec 1) (First Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Lift and Escalators Sectional committee was approved by the Electrotechnical Division Council.

This standard contains extracts of EN 115 : 1995 + A1 : 1998 + A2 : 2004 'Safety rules for the construction and installation of escalators and passenger conveyors' reproduced with the permission of CEN.

The guidelines for installation and maintenance of escalators were earlier covered in IS 4591 : 1968. There has been tremendous increase in usage of escalators during the past decade. Considering that escalators are being used by many without much knowledge of its operation, it is necessary that safety aspects are taken care in the manufacturing of escalators. Keeping this in view and also to align the requirements with international practices, this standard is being revised and is being brought out in three sections as follows:

IS 4591 (Part 1/Sec 1) : 2020	Escalators and moving walks: Part 1/Sec 1 Safety requirements (*first revision*)
IS 4591 (Part 1/Sec 2) : 2020	Escalators and moving walks: Part 1/Sec 2 Guide for planning and selection (*first revision*)
IS 4591 (Part 1/Sec 3) : 2020	Escalators and moving walks: Part 1/Sec 3 Inspection and Test (*first revision*)

With the publication of these standards, IS 4591 : 1968 stands withdrawn.

The objective of this standard is to provide requirements for electric escalators and moving walks that carry passengers.

The purpose of this standard is to define safety requirements for escalators and moving walks in order to safeguard people and objects against accidental risks during installation, operation, maintenance and inspection work.

The contents of this standard are based on the assumption that persons using escalators and moving walks are able to do so unaided. However, physical and sensory abilities in a population can vary over a wide range, escalators and moving walks are also likely to be used by persons with a range of other disabilities.

Some individuals, in particular older people, might have more than one impairment. Some individuals are not able to use an escalator or moving walk independently and rely on assistance/support being provided by a companion. Furthermore, some individuals can be encumbered by objects or be responsible for other persons, which can affect their mobility. The extent to which an individual is incapacitated by impairments and encumbrances often depends on the usability of products, facilities and the environment.

The use of wheelchairs on escalators and moving walks can lead to dangerous situations which cannot be mitigated by machine designs and therefore should not be permitted.

The use of lifts is the preferred method of vertical travel for most people with disabilities and in particular wheelchair users and persons with guide dogs.

Additional signs should be provided to indicate the location of other facilities, these facilities should be in close proximity to the escalators and moving walks and easy to find.

It is assumed that negotiations have been made for each contract between the customer and the supplier/installer about:

a) intended use of the escalator or moving walk;
b) environmental conditions;
c) civil engineering problems; and
d) other aspects related to the place of installation.

The composition of the Committee, responsible for the formulation of this standard is given at Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

ESCALATOR AND MOVING WALKS

PART 1 / SECTION 1 SAFETY REQUIREMENTS

(First Revision)

1 SCOPE

1.1 This standard is applicable for all new escalators and moving walks (pallet or belt type) as defined in **3**.

This standard deals with all significant hazards, hazardous situations and events relevant to escalators and moving walks when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

1.2 This standard does not deal with hazards arising from seismic activities.

1.3 This standard is not applicable to escalators and moving walks which were manufactured before the date of its publication. It is, however, recommended that existing installations be adapted to this standard.

2 REFERENCES

The Indian Standards listed in Annex A and contain provisions which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

List of informative standards is given at Annex B.

3 TERMS AND DEFINITIONS — SYMBOLS AND ABBREVIATIONS

3.1 Terms and Definitions

For the purposes of this standard, the terms and definitions given below shall apply.

3.1.1 *Angle of Inclination* — Maximum angle to the horizontal in which the steps, the pallets or the belt move.

3.1.2 *Balustrade* — Part of the escalator/moving walk which ensures the user's safety by providing stability, protecting from moving parts and supporting the handrail.

3.1.3 *Balustrade Decking* — Transverse member of the balustrade which meets the handrail guidance profile and which forms the top cover of the balustrade.

3.1.4 *Brake Load* — Load on the step/pallet/belt which the brake system is designed to stop the escalator/ moving walk.

3.1.5

a) *Comb* — Pronged section at each landing that meshes with the grooves of steps/pallets.

b) *Comb Plate* — Platform at each landing to which the combs are attached.

3.1.6 *Electrical Safety System* — Safety related part of the electrical control system as an arrangement of safety circuits and monitoring devices.

3.1.7 *Electrical Safety Devices* — Part of a safety circuit consisting of safety switches and/or fail safe circuits.

3.1.8 *Escalator* — Power-driven, inclined, continuous moving stairway used for raising or lowering persons in which the user carrying surface (for example, steps) remains horizontal.

NOTE — Escalators are machines even when they are out of operation and cannot be considered as fixed staircases.

3.1.9 *Exterior Panel* — Part of the exterior side of the enclosure of an escalator or moving walk.

3.1.10 *Fail Safe Circuit* — Safety related electrical and/or electronic system with defined failure mode behavior.

3.1.11 *Handrail* — Power-driven moving rail for persons to grip while using the escalator or moving walk.

3.1.12 *Interior Panel* — Panel located between the skirting or lower inner decking and the handrail guidance profile or balustrade decking.

3.1.13

a) *Lower Inner Decking* — Profile that connects the skirting with the interior panel when they do not meet at a common point.

b) *Lower Outer Decking* — Profile that connects the exterior panels with the interior panel.

3.1.14 *Machinery* — Escalator or moving walk machine(s) mechanisms and associated equipment.

3.1.15 *Machinery Spaces* — Space(s) inside or outside of the truss where the machinery as a whole or in parts is placed.

3.1.16 *Maximum Capacity* — Maximum flow of persons that can be achieved under operational conditions.

3.1.17 *Moving Walk* — Power-driven installation for the conveyance of persons in which the user carrying surface remains parallel to its direction of motion and is uninterrupted (for example, pallets, belt).

NOTE — Moving walks are machines — even when they are out of operation, and should not be used as a fixed access.

3.1.18 *Newel* — End of the balustrade.

3.1.19 *Nominal Speed* — Speed in the direction of the moving steps, pallets or the belt, when operating the equipment under no load condition (that is, without persons), stated by the manufacturer as that for which the escalator or moving walk has been designed.

NOTE — Rated speed is the speed the escalator/moving walk moves under rated load conditions.

3.1.20 *Rated Load* — Load which the equipment is designed to move.

NOTE — For maximum capacity, *see* **4.1** of IS 4591 (Part 1/Sec 2) .

3.1.21 *Rise* — Vertical distance between the upper and lower finished floor levels.

3.1.22 *Safety Circuit* — Part of the electric safety system consisting of electrical safety devices.

3.1.23 *Skirting* — Vertical part of the balustrade interfacing with the steps, pallets or belt.

3.1.24 *Skirt Deflector* — Device to minimize the risk of trapping between the step and the skirting.

3.1.25 *Stand-by Operation* — Mode in which an escalator/moving walk can be stopped or operated under no load condition with any speed below the nominal speed.

3.2 Symbols and Abbreviations

The symbols and corresponding units of measurement of the following Table 1 are used in this standard.

4 ESCALATORS AND MOVING WALKS OPERATING UNDER SPECIAL CONDITIONS

If escalators or moving walks are intended to be operated under special conditions, such as directly exposed to the weather or explosive atmosphere, or in exceptional cases serve as emergency exits, appropriate design criteria, components, materials and instructions for use should be used that satisfy the particular conditions.

Table 1 Symbols and Corresponding Units of Measurement Used in this Standard

(*Clause* 3.2)

Sl No.	Symbol	Description	Unit	Figure
(1)	(2)	(3)	(4)	(5)
i)	b_1	Distance between the handrail center lines	m	3
ii)	b_2	Width of the handrail	mm	3
iii)	b_3	Horizontal distance between skirting and interior panel	mm	3
iv)	b_4	Width of the horizontal part of the lower inner decking that directly joins the interior panel	mm	3
v)	b_5	Horizontal distance between the inner edge of the handrail and the top edge of the interior panel	mm	3
vi)	$b_{6'}$, $b_{6''}$	Horizontal distance between the handrail profile and guide or cover profiles	mm	3
vii)	b_7	Width of the grooves	mm	2
viii)	b_8	Web width	mm	2
ix)	b_{10}	Horizontal distance between the outer edge of the handrail and a continuous obstruction e.g. wall	mm	4
x)	b_{11}	Horizontal distance between the handrail of adjacent escalators/moving walks	mm	3
xi)	b_{12}	Vertical distance between the lower edge of the handrail and the balustrade decking	mm	3
xii)	b_{13}	Width of the lower outer decking	mm	4

Table 1 (*Concluded*)

Sl No. (1)	Symbol (2)	Description (3)	Unit (4)	Figure (5)
xiii)	b_{14}	Horizontal distance between the outer edges of interior panels on adjacent escalators /moving walks	mm	4
xiv)	b_{15}	Horizontal distance between the building structure (wall) and the centreline of the handrail	mm	4
xv)	b_{16}	Horizontal distance between the centrelines of the handrails of adjacent escalators/moving walks	mm	4
xvi)	b_{17}	Horizontal distance of the anti-slide device to the outer edge of the handrail	mm	4
xvii)	h_1	Vertical distance between the top of the handrail and step nose or pallet surface or belt surface	m	2, 3
xviii)	h_2	Vertical distance between top edge of skirting or bottom edge of cover joints and the line of the step nose or the tread surface of the pallet or belt	mm	3
xix)	h_3	Distance between the entry of handrail into the newel and the floor	m	2, 3
xx)	h_4	Free height above the any point of step surface, pallet or belt over the area between both edges of the handrails	m	2
xxi)	h_5	Height of deflector	m	2, 4
xxii)	h_6	Clearance between the upper edge of the tread surface and the root of the comb teeth	mm	2
xxiii)	h_7	Depth of the grooves	mm	2
xxiv)	h_8	Mesh depth of the comb into the grooves of the tread	mm	2
xxv)	h_9	Vertical distance between floor and lower end of the anti-climbing device	mm	4
xxvi)	h_{10}	Vertical distance between lower edge of the handrail and upper end of the access restriction device	mm	4
xxvii)	h_{11}	Height of the anti-slide device	mm	4
xxviii)	h_{13}	Vertical distance between the upper and lower finished floor levels	m	2
xxix)	L_1	Root of comb teeth	–	2
xxx)	l_1	Horizontal distance between supports	m	2
xxxi)	L_2	Comb insertion line	–	2
xxxii)	l_2	Distance between the furthest point reached by the handrail and the comb intersection line measured parallel to the tread surface	m	2
xxxiii)	l_3	Length of the straight portion of the handrail in the direction of landing measured from the comb intersection line	m	2
xxxiv)	l_4	Distance between the furthest point reached by the handrail and the point of entry into the newel measured parallel to the tread surface.	m	2
xxxv)	l_5	Length of anti-climbing device on the lower outer decking	mm	4
xxxvi)	V	Nominal speed	m/s	–
xxxvii)	x_1	Step height	m	5
xxxviii)	y_1	Step depth	m	5
xxxix)	z_1	Nominal width for the load carrying area (step, pallet or belt)	m	3, 5
xl)	z_2	Horizontal distance between skirting and interior panel	m	3
xli)	z_3	Transverse distance between the supporting rollers	mm	8
xlii)	α	Angle of inclination of the escalator or moving walk	° (degree)	2
xliii)	β	Design angle of the teeth of the comb	° (degree)	2
xliv)	Υ	Cross-sectional angle of inclination of the lower inner decking	° (degree)	3
xlv)	μ	Friction coefficient	–	–

5 SAFETY REQUIREMENTS AND PROTECTIVE MEASURES

5.1 General

Escalators and moving walks shall comply with the safety requirements and/or protective measures of this clause. In addition, escalators and moving walks shall be designed for relevant but not significant hazards, which are not dealt with by this standard.

Certain escalators and moving walks are subject to special operational and environmental conditions. For these cases, some additional recommendations are defined (*see* **4.2** of IS 4591 (Part 1/Sec 2).

5.2 Supporting Structure (Truss) and Enclosure

5.2.1 *General*

5.2.1.1 All mechanically moving parts of the escalator or moving walk shall be completely enclosed within imperforate panels or walls. Exempt from this are the accessible steps, the accessible pallets, the accessible belt and that part of the handrail available for the user. Apertures for ventilation are permitted (*see* also **5.2.1.5**).

5.2.1.2 The exterior panels shall withstand a force of 250 N at any point at right angles on an area of 25 cm² without breakage or deflection resulting in any gap. The fixing shall be designed in that way to carry at least twice the dead load of the enclosure.

5.2.1.3 It is permissible to omit an enclosure of the mechanically moved parts if other measures (such as, rooms with locked doors accessible to authorized personnel only) make a hazard to the public impossible.

5.2.1.4 Accumulation of materials (for example, grease, oil, dust, paper) represents a fire risk. Therefore it should be possible to clean the inner part of escalator/moving walk.

5.2.1.5 Ventilation apertures shall be built or arranged such that it shall not be possible to pass a straight rigid rod 10 mm in diameter through the enclosure and to touch any moving part through a ventilation aperture.

5.2.1.6 Any exterior panels which are designed to be opened (for example, for cleaning purposes) shall be provided with an electric safety device according to Table 6 (xiv).

5.2.2 *Angle of Inclination*

The angle of inclination α of the escalator shall not exceed 30°, but for rises h_{13} not exceeding 6 m and a nominal speed not exceeding 0.50 m/s the angle of inclination is permitted to be increased up to 35° (*see* α in Fig. 2).

The angle of inclination of moving walks shall not exceed 12°.

5.2.3 *Access to the Interior*

Machinery spaces inside the truss shall only be accessible to authorized persons (for example, by key, access control).

5.2.4 *Inspection Covers and Floor Plates*

Inspection covers and floor plates shall be provided with a control device according to Table 6 (xiv).

It shall only be possible to open inspection covers and floor plates by a key or a tool suited for that purpose.

If rooms behind inspection covers and floor plates can be entered, it shall be possible to open them from the inside without a key or a tool even when locked.

Inspection covers and floor plates shall be imperforate. Inspection covers shall conform to the same conditions as required for the location where they are installed.

5.2.5 *Structural Design*

The supporting structure shall be designed in a way that it can support the dead weight of the escalator or moving walk plus a rated load of 5 000 N/m². It shall be calculated in accordance with h and book SP 6 (Part 6).

NOTE — Load carrying area = (nominal width z_1 (*see* Fig. 3) of the escalator or moving walk) × (distance l_1 between the supports) (*see* Fig. 2).

Based on the rated load, the maximum calculated or measured deflection shall not exceed 1/750 of the distance l_1 between the supports.

5.3 Steps, Pallets, Belt

5.3.1 *General*

In the user carrying area of the escalator, the step treads shall be horizontal with a tolerance of ± 1° in the direction of travel.

NOTE — The maximum permissible height between two consecutive steps at the landings is defined in **5.3.4** and **5.7.2.1**.

Tread surfaces for escalators and moving walks shall provide a secure foothold.

5.3.2 *Dimensions*

5.3.2.1 *General*

For escalators and moving walks the nominal width z_1 shall not be less than 0.58 m and not exceed 1.10 m.

For moving walks with an angle of inclination up to 6° widths up to 1.65 m are permitted.

5.3.2.2 *Step treads and pallets* (*see* Fig. 2, detail × and Fig. 5)

5.3.2.2.1 The step height x_1 shall not exceed 0.24 m.

5.3.2.2.2 The step depth y_1 shall not be less than 0.38 m.

5.3.2.2.3 The surface of the step treads and pallets shall have grooves in the direction of movement with which the teeth of the combs mesh.

5.3.2.2.4 The step risers shall be cleated and the surface of the cleat shall be smooth. The ends of the step tread shall mesh with the cleating of the next step riser.

5.3.2.2.5 The width b_7 of the grooves shall be at least 5 mm and not exceed 7 mm.

5.3.2.2.6 The depth h_7 of the grooves shall not be less than 10 mm.

5.3.2.2.7 The web width b_8 shall be at least 2.5 mm and not exceed 5 mm.

5.3.2.2.8 The step treads and step risers or pallets shall not finish with a groove at their side edges.

5.3.2.2.9 The edge between the surface of the step tread and the riser shall not have any sharpness.

5.3.2.3 *Belts* (*see* Fig. 2, detail X)

5.3.2.3.1 The belts shall have grooves in the direction of travel with which the teeth of the comb mesh.

5.3.2.3.2 The width b_7 of the grooves shall be at least 4.5 mm and not exceed 7 mm, and shall be measured at the tread surface of the belt.

5.3.2.3.3 The depth h_7 of the grooves shall not be less than 5 mm.

5.3.2.3.4 The web width b_8 shall be at least 4.5 mm and not exceed 8 mm and shall be measured at the tread surface of the belt.

5.3.2.3.5 The belt shall not finish with a groove at the side edge of the belt.

Splicing of the treadway belt shall be, such as to provide a continuous unbroken treadway surface.

5.3.3 *Structural Design*

5.3.3.1 *General*

The materials shall retain their strength characteristics during their specified life cycle taking into account the environmental conditions, for example, temperature, ultra violet radiation, humidity, corrosion.

The steps, pallets and the belt shall be designed to withstand all possible loading and distortion effects, which may be imposed by the tracking, guiding and driving system during normal operation and shall be designed to support an equally distributed load corresponding to 6000 N/m^2.

NOTE — 6 000 N/m^2 is derived from a static load of 5 000 N/m^2 (*see* **5.2.5**) plus an impact factor of 1.2.

To establish the dimensions of the belt and its supporting system, an area of effective width × 1.0 m length shall be taken as a basis for this corresponding load (in addition the requirements of **5.3.3.2.4** shall be complied with).

Assembled steps and pallets shall be designed such that all component parts for example, inserts or fixings are securely attached and do not become loose during their life cycle. The inserts and fixings shall withstand the reaction force of operating the comb/comb plate electric safety device (Table 6 (vii)).

5.3.3.2 *Static test*

5.3.3.2.1 *Steps*

The step shall be tested for deflection with a single force of 3 000 N (including weight of the plate) applied perpendicular to the tread surface on a steel plate 0.20 m × 0.30 m in size and at least 25 mm thick, in the centre of the tread surface. The edge of the plate being 0.20 m long shall be arranged parallel to the front edge of the step, the edge of the plate being 0.30 m long at right angles to the front edge of the step.

During this test, the deflection measured at the tread surface shall not be more than 4 mm. There shall be no permanent deformation (initial setting tolerances are permitted).

The step shall be tested as a whole together with rollers (not rotating), axles or stub shafts (if existing) in a horizontal position (horizontal support) and at the maximum inclination (inclined support) for which the step is to be applied.

For all inclinations smaller than the maximum inclination permitted, a new test is not required. A test of the installed step, that is, together with the guide rails and the supporting structure of the escalator, is also not necessary.

5.3.3.2.2 *Step riser*

The riser shall not deflect by more than 4 mm, when subjected to a single load of 1500 N applied normal to the surface, on an area of 25 cm^2, using a square or round steel plate, minimum thickness 25 mm, shaped to fit the risers curvature.

This load shall be applied in three positions across the width of the riser, on the centre line, in the middle and at both ends. There shall be no permanent deformation.

5.3.3.2.3 *Pallets*

The pallet shall be tested for deflection with a single force which, for a pallet area of 1 m^2, shall be 7 500 N (including weight of the plate). The force shall be applied perpendicular to the tread surface on a steel plate 0.30 m × 0.45 m in size and at least 25 mm thick, in the centre of the tread surface, and the edge of the plate being 0.45 m long shall be arranged parallel to the lateral edge of the pallet.

For pallets with smaller or larger areas, the force and the loading area shall be changed proportionally, whereby for the loading area the ratio of edge length shall be 1 : 1.5, however, the force shall be not below 3 000 N (including weight of the plate), the size of the plate be not smaller than 0.20 m × 0.30 m and its thickness be not less than 25 mm.

For pallets with a depth smaller than 0.30 m the plate width shall be 0.20 m and the length of the plate shall be the depth of the pallet.

During this test the deflection measured at the tread surface shall not be more than 4 mm. There shall be no permanent deformation (initial setting tolerances are permitted).

The pallet shall be tested as a whole together with rollers (not rotating), axles or stub shafts (if existing) in a horizontal position. A test of the installed pallet, that is, together with the guide rails and the supporting structure of the moving walk, is not required.

5.3.3.2.4 *Belts*

With the belt tensioned to suit operational conditions, a single force of 750 N (including weight of the plate) shall be applied on a steel plate 0.15 m × 0.25 m × 0.025 m in size. The plate shall be placed centrally between the edge supporting rollers in such a way that its longitudinal axis is parallel to the longitudinal axis of the belt. The deflection at the centre shall not exceed 0.01 z_3 where, z_3 is the transverse distance between the supporting rollers (*see* z_3 in Fig. 8).

5.3.3.3 *Dynamic tests*

5.3.3.3.1 *Steps*

5.3.3.3.1.1 *Load test*

The step shall be tested at the maximum inclination (inclined support) for which it is to be applied, together with rollers (not rotating), axles or stub shafts (if existing). It shall be subjected to a load pulsating between 500 N and 3 000 N at one frequency between 5 Hz and 20 Hz for at least 5 × 10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved. The load shall be applied perpendicular to the tread surface on a steel plate 0.20 m × 0.30 m in size and at least 25 mm thick, arranged as specified in **5.3.3.2.1**, in the centre of the tread surface.

After the test the step shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Steps or their component parts, for example, inserts or fixings, shall be securely attached and not become loose. If rollers are damaged during the test, it is permissible to replace them.

5.3.3.3.1.2 *Torsion test*

The step design shall be such that the structure can accommodate torsional loading equivalent to a ± 2 mm displacement of the trailer wheel centre, moving in an arc whose centre is the chain wheel centre. The ± 2 mm displacement is a relative to a trailer wheel to chain wheel centre distance of 400 mm. This ratio shall be maintained, when the 400 mm dimension is varied.

The dynamic test shall be adjustable to ensure that the specified deflections above are achieved throughout the test. It shall be applied with one frequency between 5 Hz and 20 Hz for at least 5 × 10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved.

After the test the step shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Steps or their component parts, for example, inserts or fixings, shall be securely attached and not become loose.

5.3.3.3.2 *Pallets*

5.3.3.3.2.1 *Load test*

The pallet, irrespective of its size, shall be tested in a horizontal position together with rollers (not rotating), axles or stub shafts (if existing). It shall be subjected to a load pulsating between 500 N and 3 000 N at one frequency between 5 Hz and 20 Hz for at least 5 × 10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved. It shall be applied perpendicular to the tread surface on a steel plate 0.20 m × 0.30 m in size and at least 25 mm thick, in the centre of the tread surface.

For pallets with a smaller length than 0.30 m the plate width shall be 0.20 m and the length of the plate shall be the length of the pallet.

After the test, the pallet shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Pallets or their component parts, for example, inserts or fixings, shall be securely attached and not become loose.

If rollers are damaged during the test, it is permissible to replace them.

5.3.3.3.2.2 *Torsion test*

A torsion test is only required if the pallets are fitted with trailer rollers. The pallet design shall be such that the structure can accommodate torsional loading equivalent to a ± 2 mm displacement of the trailer wheel centre, moving in an arc whose centre is the chain wheel centre. The ± 2 mm displacement is related to a trailer wheel to chain wheel centre distance of 400 mm. This ratio shall be maintained, when the 400 mm dimension is varied.

The dynamic load shall be adjusted to achieve a deflection with a tolerance of – 5 percent during the test. It shall be applied with one frequency between 5 Hz and 20 Hz for at least 5×10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved.

For pallets with a smaller length than 0.30 m, the plate width shall be 0.20 m and the length of the plate shall be the length of the pallet.

After the test, the pallet shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Pallets or their component parts, for example, inserts or fixings, shall be securely attached and not become loose.

5.3.4 *Guiding of Steps, Pallets and Belt*

The lateral displacement of the steps or pallets out of their guiding system shall not exceed 4 mm at either side or 7 mm for the sum of clearances measured at both sides and the vertical displacement shall not exceed 4 mm for steps and pallets and 6 mm for belts.

This requirement applies only to the usable area of the steps, pallets or belt.

Treadway supports for belts shall be provided at intervals not exceeding 2 m along the centre line of the treadway. These supports shall be located at a level not more than 50 mm below the underside of the treadway when it is loaded under the conditions required by **5.3.3.2.4**.

5.3.5 *Clearance between Steps or Pallets*

The clearance between two consecutive steps or pallets in any usable position measured at the tread surface shall not exceed 6 mm (*see* Fig. 2, details Y, Z, Fig. 6, detail S and Fig. 7, detail U).

Demarcation (for example, groove in the step tread) shall be provided to highlight at the landings the rear edge of the steps.

In the area of the transition curves of moving walks with meshed front edges and rear edges of the pallets, this clearance is permitted to be increased to 8 mm (*see* Fig. 7, detail V).

5.3.6 *Missing Step or Pallet Device*

A missing step/pallet (*see* Table 6 (xi)) shall be detected and the escalator/moving walk stopped before the gap (resulting from the missing step/pallet) emerges from the comb. This shall be ensured by a device provided at each driving and return station.

5.4 Drive Unit

5.4.1 *Driving Machine*

5.4.1.1 *General*

A drive unit shall not operate more than one escalator or moving walk.

5.4.1.2 *Speed*

5.4.1.2.1 The nominal speed shall not deviate by more than ± 5 percent at nominal frequency and nominal voltage.

5.4.1.2.2 The nominal speed of the escalator shall not exceed:

a) 0.75 m/s for an escalator with an angle of inclination α up to 30°; and

b) 0.50 m/s for an escalator with an angle of inclination α of more than 30° up to 35°.

Refer **5.2.2** for angle of inclination (α).

5.4.1.2.3 The nominal speed of moving walks shall not be higher than 0.75 m/s.

Deviating from the above, nominal speed up to 0.90 m/s is permitted provided the width of the pallets or the belt does not exceed 1.10 m, and at the landings, the pallets or the belt move horizontally for a length of at least 1.60 m before entering the combs.

The before mentioned requirements do not apply to moving walks with acceleration paths or moving walk systems with direct transition to moving walks travelling at different speeds.

5.4.1.3 *Link between operational brake and step, pallet or belt drive*

5.4.1.3.1 For the link between the operational brake and the step, pallet or belt drive, preferably non-friction driving elements should be used, such as, shafts, gear wheels, multiplex chains, two or more single chains.

Where friction elements are used such as trapezoidal belts (flat belts are not permitted) an auxiliary brake in accordance with **5.4.2.2** shall be used.

5.4.1.3.2 Safety factors of all driving elements shall be at least 5 for static calculations. In the case of trapezoidal belts, at least 3 belts shall be applied.

This safety factor is determined as the ratio between the breaking force of the driving element and the static force to which the driving element is subjected when the escalator or inclined moving walk carries the rated load (person weight) according to **5.2.5** together with the tension force of the tensioning device.

For horizontal moving walks, the dynamic forces according to **5.4.2.1.3.3** respectively **5.4.2.1.3.4** together with the tension force of the tensioning device shall be used to determine the safety factor.

5.4.1.4 *Hand winding device*

If a hand winding device is provided it shall be easily accessible and safe to operate (*see* **7.2.1.3** and 7.1 (g) of IS 4591 (Part 1/Sec 2) for instructions).

If the hand winding device is removable, an electric safety device (*see* Table 6 (xvii)) in conformity with **5.12.1.2.2** shall be actuated when or before the hand winding device is put on the machine.

Crank handles or perforate hand wheels are not permitted.

5.4.1.5 *Stopping the machine and checking its stopped position*

Stopping the escalator or moving walk by means of the electric safety devices according to **5.12.1.2** shall be achieved as follows:

The supply shall be interrupted by two independent contractors, the contacts of which shall be in series in the supply circuit. If, when the escalator or moving walk is stopped, one of the main contacts of one of the contactors has not opened, restarting shall be impossible.

5.4.2 *Braking System*

5.4.2.1 *Operational brake*

5.4.2.1.1 *General*

5.4.2.1.1.1 Escalators and moving walks shall have a braking system by means of which they can be brought to rest with a uniform deceleration and maintained stationary (operational braking) *see* also **5.12.1.2.4.** There shall be no intentional delay in the application of the braking system.

If the stopping distance exceeds the maximum values of **5.4.2.1.3.2** and **5.4.2.1.3.4** by more than 20 percent, a restart shall be possible only after the failure lock has been reset (*see* Table 6 (xv)). Before manual reset, the brake system has to be investigated and corrective action has to be taken, if necessary [*see* also 7.1 (e) of IS 4591 (Part 1/Sec 2)].

A device shall be provided to monitor the lifting of the braking system after starting the escalator/moving walk (*see* also Table 6 (xii)).

5.4.2.1.1.2 The braking system shall operate automatically in the event of loss of:

a) voltage supply; and
b) voltage supply to the control circuits.

5.4.2.1.1.3 Operational braking shall be effected by an electro-mechanical brake or by other means.

Where no electro-mechanical operational brake is used, an auxiliary brake in accordance with **5.4.2.2** shall be provided.

5.4.2.1.1.4 Brakes that can be released by hand shall require continuous application of manual pressure to keep them open.

5.4.2.1.2 *Electro-mechanical brake*

The normal lifting of the electro-mechanical brake shall be by a continuous flow of electric current. The braking operation shall be effective immediately after the electric brake circuit is opened.

The brake force shall be generated by guided compression spring(s). Electrically generated self-excitation of the brake releasing device shall be impossible.

The interruption of the electricity supply shall be effected by at least two independent electric devices. They can be those which break the supply to the machine. If after the stop of the escalator or moving walk one of these electric devices has not opened, restarting shall be prevented (*see* also **5.4.1.5**).

5.4.2.1.3 *Brake load and stopping distances for operational brake*

5.4.2.1.3.1 *Determination of the brake load for escalators*

Table 2 shall be applied for the determination of the brake load for escalators.

Table 2 Determination of Brake Load for Escalators

(*Clause* 5.4.2.1.3.1)

Sl No.	Nominal Width z_1	Brake Load per Step
(1)	(2)	(3)
i)	Up to 0.60 m	60 kg
ii)	more than 0.60 m up to 0.80 m	90 kg
iii)	more than 0.80 m up to 1.10 m	120 kg

The number of steps to be considered is determined by "rise h_{13} (*see* Fig. 2) divided by maximum visible height of the step riser" (*see* x_1 in Fig. 5).

For the purpose of a test, the total brake load is permitted to be distributed over two-thirds of the number of steps thus obtained.

5.4.2.1.3.2 *Stopping distances for the escalator*

The stopping distances for unloaded and downward moving loaded escalators (*see* **5.4.2.1.3.1**) shall be as given in Table 3.

Table 3 Stopping Distances for Escalators

(*Clause* 5.4.2.1.3.2)

Sl No.	Nominal Speed v	Stopping Distance Between
(1)	(2)	(3)
i)	0.50 m/s	0.20 m and 1.00 m
ii)	0.65 m/s	0.30 m and 1.30 m
iii)	0.75 m/s	0.40 m and 1.50 m

For intermediate speeds the stopping distances shall be interpolated.

The stopping distances shall be measured from the time the electric stopping device is actuated.

The deceleration, measured on a downward moving escalator, in the direction of travel shall not exceed 1 m/s² during the operation of the braking system. The raw deceleration signal shall be band-limited using a 4.0 Hz two-pole butter worth filter.

NOTE — It is recommended to achieve the shortest possible stopping distance within the given deceleration limit.

5.4.2.1.3.3 *Determination of the brake load for moving walks*

Table 4 shall be applied for the determination of the brake load for moving walks.

Table 4 Determination of the Brake Load for Moving Walks

(*Clause* 5.4.2.1.3.3)

Sl No.	Nominal Width z_1	Brake Load per 0.4 m Length
(1)	(2)	(3)
i)	Up to 0.60 m	50 kg
ii)	more than 0.60 m up to 0.80 m	75kg
iii)	more than 0.80 m up to 1.10 m	100 kg
iv)	more than 1.10 m up to 1.40 m	125 kg
v)	more than 1.40 m up to 1.65 m	150 kg

To determine the brake load for moving walks which in their length overcome several inclinations (differences in level), only the downward running sections shall be considered.

5.4.2.1.3.4 *Stopping distances for moving walks*

The stopping distances for unloaded and horizontally or downward moving loaded moving walks (*see* **5.4.2.1.3.3**) shall be as given in Table 5.

Table 5 Stopping Distances for Moving Walks

(*Clause* 5.4.2.1.3.4)

Sl No.	Nominal Speed v (in m/s)	Stopping Distance Between (in m)
(1)	(2)	(3)
i)	0.50	0.20 and 1.00
ii)	0.65	0.30 and 1.30
iii)	0.75	0.40 and 1.50
iv)	0.90	0.55 and 1.70

For intermediate speeds the stopping distances shall be interpolated.

The stopping distances shall be measured from the time the electric device for stopping is actuated.

The deceleration, measured on a downward moving or horizontal moving walk, in the direction of travel shall not exceed 1 m/s² during the operation of the braking system. The raw deceleration signal shall be band limited using a 4.0 Hz two-pole Butterworth filter.

NOTE — It is recommended to achieve the shortest possible stopping distance within the given deceleration limit. For moving walks a brake test under no load will be sufficient.

For loaded moving walks, the manufacturer shall prove the stopping distances by calculation [*see* **6.2** (c)].

5.4.2.2 *Auxiliary brake*

5.4.2.2.1 Escalators and inclined moving walks shall be equipped with auxiliary brake(s) if the:

a) connection between the operational brake (*see* **5.4.2.1**) and the driving sprockets of the steps/pallets or the drum of the belt is not accomplished by shafts, gear wheels, multiplex chains, or more than one single chain,
b) operational brake is not an electro-mechanical brake according to **5.4.2.1.2**, or
c) rise h_{13} (*see* Fig. 2) exceeds 6 m [*see* also **4.2** of IS 4591 (Part 1/Sec 2)].

The connection between the auxiliary brake and the driving sprockets of the steps/pallets or the drum of the belt shall be accomplished by shafts, gear wheels, multiplex chains or more than one single chain. It is not permissible for the connection to comprise friction drives, that is, clutches.

5.4.2.2.2 The auxiliary braking system shall be dimensioned in such a way that escalators and moving walks travelling with brake load downward are brought to rest by effective retardation and maintained stationary. The deceleration of 1 m/s² shall not be exceeded.

Upon operation of auxiliary brakes it is not necessary to keep the stopping distances defined for the operational brake (*see* **5.4.2.1.3.1**).

5.4.2.2.3 Auxiliary brakes shall be of the mechanical (friction) type.

5.4.2.2.4 Auxiliary brakes shall become effective in either of the following conditions:

a) before the speed exceeds a value of 1.4 times the nominal speed; and
b) by the time the steps and pallets or the belt change from the present direction of motion.

Its operation shall positively open the control circuit.

5.4.2.2.5 Auxiliary brake(s) are permitted to operate together with the operational brake when in case of power failure or of an interruption of a safety circuit the stopping conditions according to **5.4.2.1.3.2** and **5.4.2.1.3.4** are kept otherwise a simultaneous operation of the auxiliary and the operational braking system is only permitted under the conditions of **5.4.2.2.4**.

5.4.2.3 *Protection against risks of excessive speed and unintentional reversal of the direction of travel*

5.4.2.3.1 Escalators and moving walks shall be equipped in such a way that they stop automatically before the speed exceeds a value of 1.2 times the nominal speed (*see* Table 6 (iii)). Where speed control devices are used for this purpose they shall have switched off the escalator or moving walk before the speed exceeds a value of 1.2 times the nominal speed.

It is permissible to disregard this requirement if the design prevents excessive speed.

5.4.2.3.2 Escalators and inclined ($\alpha \geq 6°$) moving walks shall be equipped in such a way that they stop automatically by the time the steps and pallets or the belt change from the pre-set direction of travel (*see* Table 6 (iii)).

5.4.3 *Steps and Pallets Drive*

5.4.3.1 The steps of escalators shall be driven by at least two chains of which at least one shall be located on each side of the step.

The pallets of moving walks are permitted to be driven by only one chain if the parallel movement of the pallets in the usable area is ensured by other mechanical measures.

5.4.3.2 The step chain design shall be of nominally infinite fatigue life. The safety factor against breaking of each chain shall be at least 5 (*see* **5.4.1.3.2**) with respect to structural steel according to IS 2062 and with respect to quenched and tempered steel according to IS 5517 in combination with IS 3930. The step chain shall be subject to a tensile test.

When more than one chain is used it is assumed that the load is equally distributed over the chains.

5.4.3.3 The chains shall be tensioned continuously. The escalator/moving walk shall be stopped automatically before the tensioning device moves in excess of ± 20 mm (*see* Table 6 (v) and (vi)). Springs working in tension are not permitted for the tensioning device. When weights are used for tensioning they shall be safely retained should their suspension break.

5.4.4 *Belt Drive*

5.4.4.1 The factor of safety of the belt including splicing shall be at least 5 (*see* **5.4.1.3.2**) for the dynamic forces according to **5.4.2.1.3.3** respectively **5.4.2.1.3.4**. The calculation shall be carried out for the worst case.

5.4.4.2 The belt shall be driven by drums and be tensioned continuously and automatically. Springs working in tension are not permitted for the tensioning device. When weights are used for tensioning they shall be safely retained should their suspension break.

5.5 Balustrade

5.5.1 *General*

Balustrades shall be installed on each side of the escalator or moving walk.

5.5.2 *Dimensions of Balustrade*

5.5.2.1 In the inclined section the vertical height h_1 (*see* Fig. 2) from step nose or pallet surface or belt surface to top of the handrail shall not be less than 0.90 m and not exceed 1.10 m (*see* Fig. 2 and 3).

5.5.2.2 The balustrades shall have no parts on which a person would normally stand.

Appropriate measures shall be taken to discourage people from climbing on the outsides of the balustrade if there is a danger of people falling from them.

To ensure this, on escalators and moving walks devices (*see* 1 in Fig. 4) shall be provided on the lower outer decking at a point (1 000 ± 50) mm above the floor level (*see* h_9 in Fig. 4) where the bottom of the device intersects with the balustrade decking and shall extend to a length l_5 of at least 1 000 mm parallel with the balustrade decking where no stepping is possible. The device shall extend to at least a height in line with the top of the handrail not conflicting with the requirements of b_{10} and b_{12}.

Where escalators or moving walks are located adjacent to walls, devices (*see* 2 in Fig. 4) to restrict access to the balustrade decking shall be provided at the top and bottom ends of these walls when the lower outer decking width b_{13} exceeds 125 mm. On adjacent parallel arrangements, this protection shall be provided when the combined balustrade decking width b_{14} exceeds 125 mm. The device shall extend to the height h_{10}.

All exposed fastener heads for the devices shall be of the vandal resistant type.

Where handrail level balustrade decking are provided between escalators/inclined moving walks and adjacent walls, anti-slide devices (*see* 3 in Fig. 4) shall be provided on the balustrade decking when the distance b_{15} between the structure of the building (wall) and the centre line of the handrail is greater than 300 mm. These devices shall consist of objects fastened to the balustrade decking, no closer than 100 mm to the handrail (*see* b_{17}) and spaced no greater than 1 800 mm apart. The height h_{11} shall be not less than 20 mm. The devices shall have no sharp corners or edges.

The above mentioned also applies to adjacent escalators/inclined moving walks when the distance b_{16} between the centre lines of the handrails is greater than 400 mm.

5.5.2.3 Balustrades shall be designed to resist the simultaneous application of a static lateral force of 600 N and a vertical force of 730 N, both equally distributed over a length of 1 m and acting on the top of the handrail guiding system in the same place.

5.5.2.4 The parts of the balustrade facing the steps, pallets or belt shall be smooth and flush. Covers not in the direction of travel shall not project more than 3 mm. They shall be rigid and have rounded or beveled edges. Covers of such nature are not permitted at the skirting.

Cover joints in the direction of travel (in particular between the skirting and the interior panel) shall be arranged and formed in such a manner as to eliminate any risk of harm caused by trapping.

Gaps between the interior panels of the balustrade shall be not wider than 4 mm. The edges shall be rounded off or bevelled.

When a force of 500 N is applied to the interior panel at any point of the panelling at right angles on an area of 25 cm^2, there shall be no gap greater than 4 mm and no permanent deformation.

If glass is used for the interior panel, it shall be toughened glass. The minimum thickness of 6 mm shall apply to single layer balustrades. When multi-layer glass balustrades are used, they shall be laminated toughened glass. The thickness of at least one layer shall also be not less than 6 mm.

5.5.2.5 The horizontal distance (measured at right angles to the direction of travel) between the interior panel at lower points shall be equal to or less than the horizontal distance measured at points higher up.

5.5.2.6 The lower inner decking and the interior panel shall have an angle of inclination γ of at least 25° to the horizontal (*see* Fig. 3). This does not apply to the horizontal part of the lower inner decking that directly joins the interior panel (*see* b_4 in Fig. 3).

5.5.2.6.1 The horizontal part *b*4 up to the interior panel shall be less than 30 mm.

5.5.2.6.2 The width b_3, measured horizontally, of each lower inner decking inclined at an angle of less than 45° to the horizontal shall be less than 0.12 m (*see* Fig. 3).

5.5.3 *Skirting*

5.5.3.1 The skirting shall be vertical, plain and butt-jointed.

NOTE — However, special arrangements instead of butt-jointing (for example, sliding joints) will possibly be necessary for long moving walks at the points where they pass over building expansion joints.

5.5.3.2 The perpendicular distance h_2 between top edge of skirting or bottom edge of projecting cover joints or the lower edge of the rigid part of skirt deflectors (for definition, *see* **3.1.24**) and the line of the step nose or the tread surface of the pallets or belt shall be not less than 25 mm (*see* Fig. 3).

5.5.3.3 The skirting shall yield not more than 4 mm under a single force of 1500 N acting at the most unfavourable point at right angles to the surface over an area of 2500 mm^2 using a square or round area. No permanent deformation shall result from this.

5.5.3.4 On escalators, the possibility of trapping (trapping of any foreign element; for example, clothes, shoes, slippers, foot finger, stone etc.) between skirting and steps shall be minimized.

For this purpose, the following four conditions shall be fulfilled:

a) sufficient rigidity of the skirting according to **5.5.3.3**;
b) clearances to be in accordance with **5.5.5.1**;
c) installation of skirt deflectors which fulfil the following requirements:
    1) They shall consist of a rigid and a flexible part (for example, brushes, rubber profiles).
    2) They shall have a minimum projection of 33 mm and a maximum of 50 mm from the vertical face of the skirt panels.
    3) They shall withstand a force of 900 N uniformly distributed on the projected area of the rigid part over a rectangular area of 600 mm^2 vertically to the line of attachment of the rigid part without detachment or permanent deformation.
    4) The rigid parts shall have a horizontal projection of between 18 mm and 25 mm and withstand the defined strength requirements. The horizontal projection of the flexible part shall have a minimum of 15 mm and a maximum of 30 mm.
    5) A distance of (25^{+2}_{-0}) mm shall be provided between the lowest part of the underside of the rigid part and perpendicular to the line of the step nose, throughout the inclined portion of travel.
    6) The distance between the lowest part of the underside of the rigid part of the skirt deflector and the top of any step cleat in the transition and horizontal areas shall be between 25 mm and 50 mm.
    7) The lower surface of the rigid part shall be bevelled not less than 25° upward and the upper surface shall be bevelled not less than 25° downward from skirt panel.
    8) The deflectors shall be designed with rounded edges. Fastening heads and joint connections shall not extend into the path of travel.
    9) The terminal end piece shall be tapered to give a flush interface with the skirting. The terminal end piece of any deflector device shall end not less than 50 mm and maximum 150 mm prior to the comb intersection line.

   10) If the skirt deflector is an extension of the lower inner decking, **5.5.2.6.2** applies. If the skirt deflector is attached or an integral part of the skirting, **5.5.3.1** apply.

d) use of suitable materials or suitable type of lining underneath the deflector device in order to achieve a coefficient of friction (μ) for leather (wet and dry), PVC (dry) and rubber (dry) less than 0.45.

5.5.4 *Newel*

5.5.4.1 The newel including the handrails shall project horizontally beyond the comb intersection line by at least 0.60 m in longitudinal direction (*see* L_2 and l_2 in Fig. 2 and detail X).

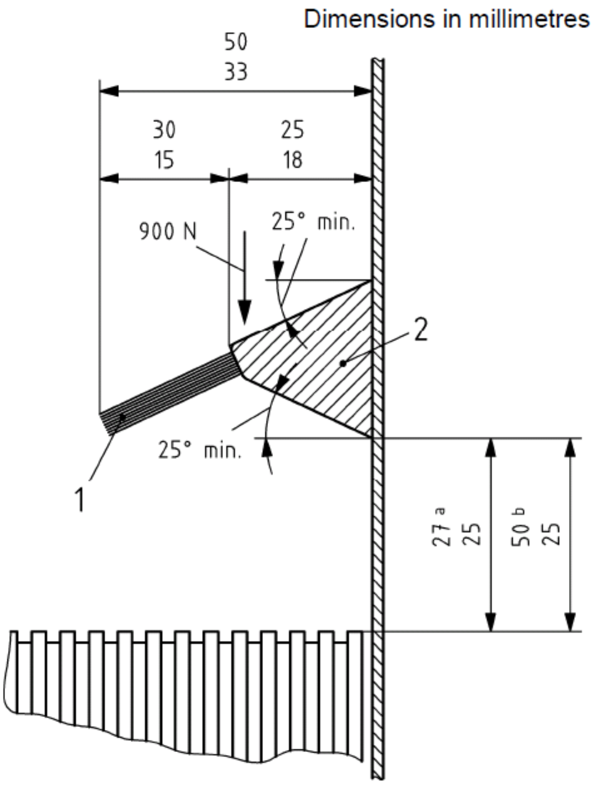
5.5.4.2 The horizontal portion of the handrail shall continue longitudinally at the landings for a distance l_3 (*see* Fig. 2) of at least 0.30 m past the comb intersection line (*see* L_2 in Fig. 2 and detail X).

In the case of inclined moving walks without a horizontal section at the landings, the continuation of the handrail parallel to the angle of inclination is permitted.

5.5.5 *Clearance between Steps, Pallets or Belt and Skirting*

5.5.5.1 Where the skirting of escalators or moving walks is placed beside the steps and pallets or the belt the horizontal clearance shall not exceed 4 mm at either side, and 7 mm for the sum of clearances measured at both sides at two directly opposite points.

5.5.5.2 Where the skirting of moving walks finishes above the pallets or the belt, the clearance shall not exceed 4 mm measured vertically from the tread surface. Motion of the pallets or the belt in lateral direction shall not cause a gap between the sides of the pallets or the belt and the vertical projection of the skirting.



Key

1 flexible part
2 rigid part
a in the inclined area
b in the transition and horizontal areas

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

FIG. 1 REQUIREMENTS ON SKIRT DEFLECTORS

5.6 Handrail System

5.6.1 *General*

On the top of each balustrade there shall be provided a handrail moving in the same direction and at a speed with a tolerance of – 0 percent to + 2 percent relative to the actual speed of the steps, pallets or belt under normal operating conditions.

A handrail speed monitoring device (*see* Table 6 xiii) shall be provided and shall stop the escalator or moving walk in the event of a hand rail speed deviation of more than –15 percent to the actual speed for more than 15 s while the escalator or moving walk is in motion.

5.6.2 *Profile and Position*

5.6.2.1 The handrail profiles and their guides on the balustrades shall be formed or enclosed in such a way that the possibility of pinching or trapping of fingers or hands is reduced.

The distance between the handrail profile and guide or cover profiles shall under no circumstances be wider than 8 mm (*see* $b_{6'}$ and $b_{6''}$ in Fig. 3, detail W).

5.6.2.2 The width b_2 of the handrail shall be between 70 mm and 100 mm (*see* Fig. 3, detail W).

5.6.2.3 The distance b_5 between the handrail and the edge of the balustrade shall not exceed 50 mm (*see* Fig. 3).

5.6.3 *Distance between the Handrail Centre Lines*

The distance b_1 between the centre line of the handrails shall not exceed the distance between the skirting by more than 0.45 m (*see* b_1 and z_2 in Fig. 3).

5.6.4 *Handrail Entry*

5.6.4.1 The lowest point of entry of the handrail into the newel shall be at a distance h_3 from the finished floor level which shall be not less than 0.10 m and not exceed 0.25 m (*see* Fig. 2 and 3).

5.6.4.2 The horizontal distance l_4 between the furthest point reached by the handrail and the point of entry into the newel shall be at least 0.30 m (*see* Fig. 2). If l_4 is greater than ($l_2 - l_3$ + 50 mm) the handrail shall enter into the balustrade at an angle α of at least 20° measured to the horizontal.

5.6.4.3 At the point of entry of the handrail into the newel a guard shall be installed to prevent the pinching of fingers and hands. A switch according to Table 6 (ix) shall be provided.

5.6.5 *Guiding*

The handrail shall be guided and tensioned in such a way that it will not leave its guides during normal use.

5.7 Landings

5.7.1 *Surface Properties*

The landing area of escalators and moving walks (that is, comb plate and floor plate) shall have a surface that provides a secure foothold for a minimum distance of 0.85 m measured from the root of the comb teeth (*see* L_1 in Fig. 2 and detail X).

Exempt from this are the combs mentioned in **5.7.3.**

5.7.2 *Configuration of Steps, Pallets and Belts*

5.7.2.1 At the landings, the steps of the escalator shall be guided in such a way that the front edges of the steps leaving the comb and the rear edges of the steps entering the comb are moving horizontally for a length of at least 0.80 m measured from point L_1 (*see* Fig. 2 and detail X).

At nominal speeds above 0.50 m/s and not more than 0.65 m/s or rises h_{13} above 6 m this length shall be at least 1.20 m, measured from point L_1 (*see* Fig. 2 and detail X).

At nominal speeds above 0.65 m/s this length shall be at least 1.60 m measured from point L_1 (*see* Fig. 2 and detail X).

A vertical difference in level between two consecutive steps of 4 mm is permitted.

5.7.2.2 For escalators, the radius of curvature in the upper transition from incline to horizontal shall be:

a) at least 1.00 m for nominal speeds $v \leq 0.5$ m/s (inclination of *Max*. 35°);

b) at least 1.50 m for nominal speeds 0.5 m/s $< v \leq$ 0.65 m/s (inclination of *Max.* 30°);

c) at least 2.60 m for nominal speeds $v > 0.65$ m/s (inclination of *Max*. 30°); and

d) The radius of curvature in the lower transition from incline to horizontal of the escalator shall be at least 1.00 m up to 0.65 m/s the nominal speed and at least 2.00 m above 0.65 m/s.

5.7.2.3 For belt moving walks, the radius of curvature in the transition from incline to horizontal shall be at least 0.40 m.

For pallet moving walks, it is not necessary to determine the radius of curvature because, on account of the maximum permissible distance between two consecutive pallets (*see* **5.3.5**) it will always be sufficiently large.

5.7.2.4 At the upper landings of moving walks with an inclination of more than 6°, the pallets or belt shall move for a length of at least 0.40 m at a maximum angle of 6° before entering or after leaving the comb.

Analogous to **5.7.2.1**, for pallet moving walks the movement is specified as follows:

The front edge of the pallet leaving the comb and the rear edge of the pallet entering the comb shall move without changing the degree of angle over at least 0.40 m.

5.7.2.5 Provisions shall be made in the area of the combs to ensure the correct meshing (*see* **5.7.3.3**) of the comb teeth with the grooves of the tread surface.

Belts shall be supported in this area in a suitable manner, for example, by drums, rollers, sliding plates.

If any part of the step or pallet is sagging so that meshing of the combs is no longer ensured a safety device according to Table 6 x) shall be provided to stop the escalator or moving walk. This safety device shall be arranged before each transition curve at a sufficient distance before the comb intersection line to ensure that the step or pallet which has sagged does not reach the comb intersection line (*see* stopping distances defined in **5.4.2.1.3.2** and **5.4.2.1.3.4**). The monitoring device may be applied at any point of the step or pallet.

5.7.3 *Combs*

5.7.3.1 *General*

Combs shall be fitted at both landings to facilitate the transition of users. The combs shall be easily replaceable.

5.7.3.2 *Design*

5.7.3.2.1 The teeth of the combs shall mesh with the grooves of the steps, pallets or belt (*see* **5.7.3.3**). The width of the comb teeth shall be not less than 2.5 mm, measured at the tread surface (*see* Fig. 2, detail X).

5.7.3.2.2 The ends of the combs shall be rounded off and so shaped as to minimize the risk of trapping between combs and steps, pallets or belt.

The radius of the teeth end shall be not greater than 2 mm.

5.7.3.2.3 The teeth of the comb shall have a form and inclination so that the feet of users, leaving the escalator or moving walk, should not stub against them. The design angle β shown in Fig. 2, detail × shall not exceed 35°.

5.7.3.2.4 The combs or their supporting structure shall be adjustable, to ensure correct meshing (*see* Fig. 2, detail X).

5.7.3.2.5 The combs shall have such a design that upon trapping of foreign bodies either their teeth deflect and remain in mesh with the grooves of the steps, pallets or belt, or they break.

5.7.3.2.6 In the case of objects being trapped which are not dealt with by the means described in **5.7.3.2.5** and in the case of comb/step/pallet impact the escalator or moving walk shall be stopped automatically (*see* Table 6 vii).

5.7.3.3 *Mesh depth of the combs into the grooves*

5.7.3.3.1 The mesh depth h_8 of the combs into the grooves of the tread (*see* Fig. 2, detail X) shall be at least 4 mm.

5.7.3.3.2 The clearance h_6 (*see* Fig. 2, detail X) shall not exceed 4 mm.

5.8 Machinery Spaces, Driving Station and Return Stations

5.8.1 *General*

These rooms/spaces shall be used only for accommodating the equipment necessary for the operation and maintenance and inspection of the escalator or moving walk.

Fire alarm systems, equipment for direct fire abatement and sprinkler heads, provided they are sufficiently protected against incidental damage, are permitted in these rooms provided they do not generate additional risks for maintenance operation.

NOTE — *See* **7.1** d), e), f) of IS 4591 (Part 1/Sec 2) for maintenance requirements and inspection activities.

Effective protection and guards shall be provided for moving and rotating parts if they are accessible and dangerous, in particular for:

a) keys and screws in shafts;
b) chains, belts;
c) gears, gear wheels, sprockets;
d) projecting motor shafts;
e) speed governors not enclosed;
f) step and pallet reversal in driving stations and/or return stations if these must be entered for maintenance purposes;
g) hand wheels and brake drums.

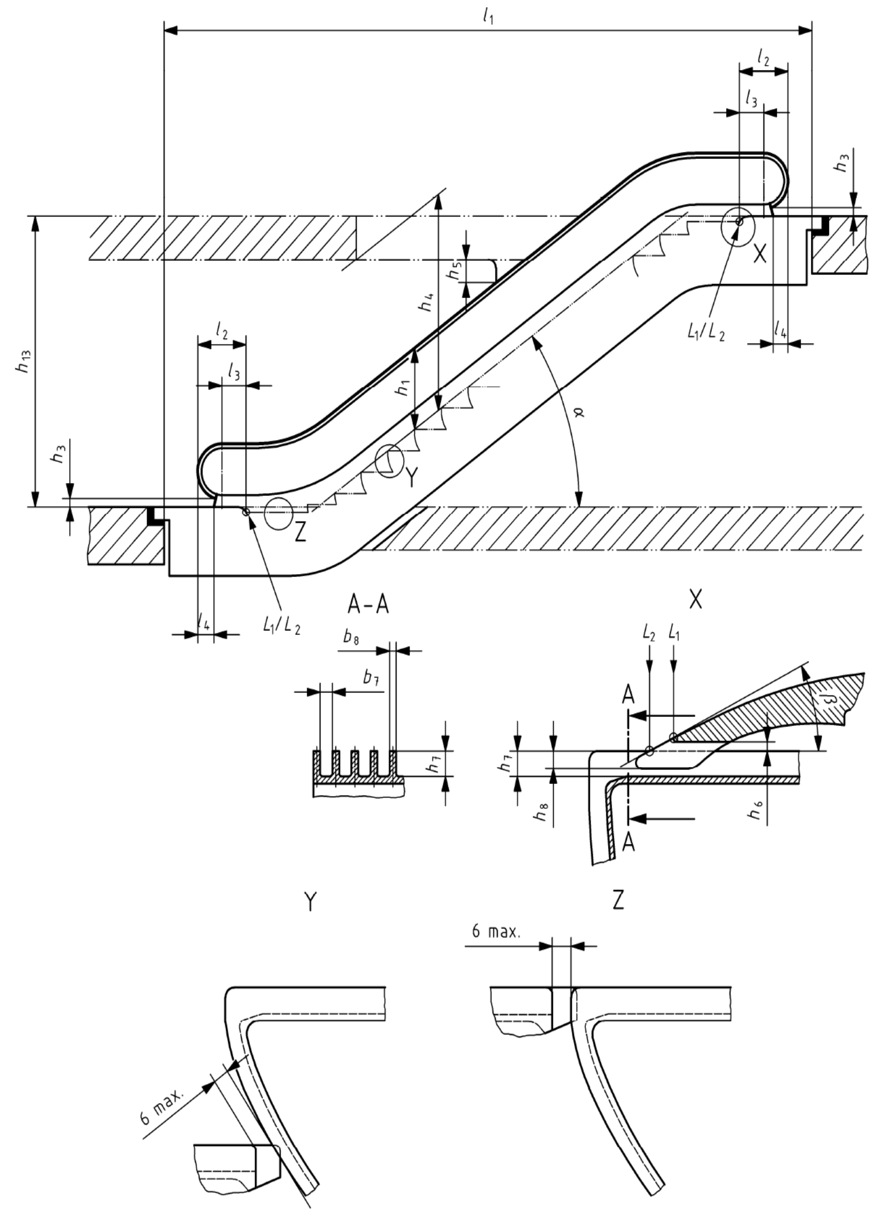
5.8.2 *Dimensions and Equipment*

5.8.2.1 In machinery spaces, especially in driving and return stations inside the truss, space with a sufficiently large standing area shall be kept free from permanently installed parts of any kind. The size of the standing area shall be at least 0.30 m^2 and the smaller side shall be at least 0.50 m long.

5.8.2.2 If the controller cabinet has to be moved or lifted for maintenance purposes, then suitable attachments for lifting shall be provided, for example, eyebolts, handle.

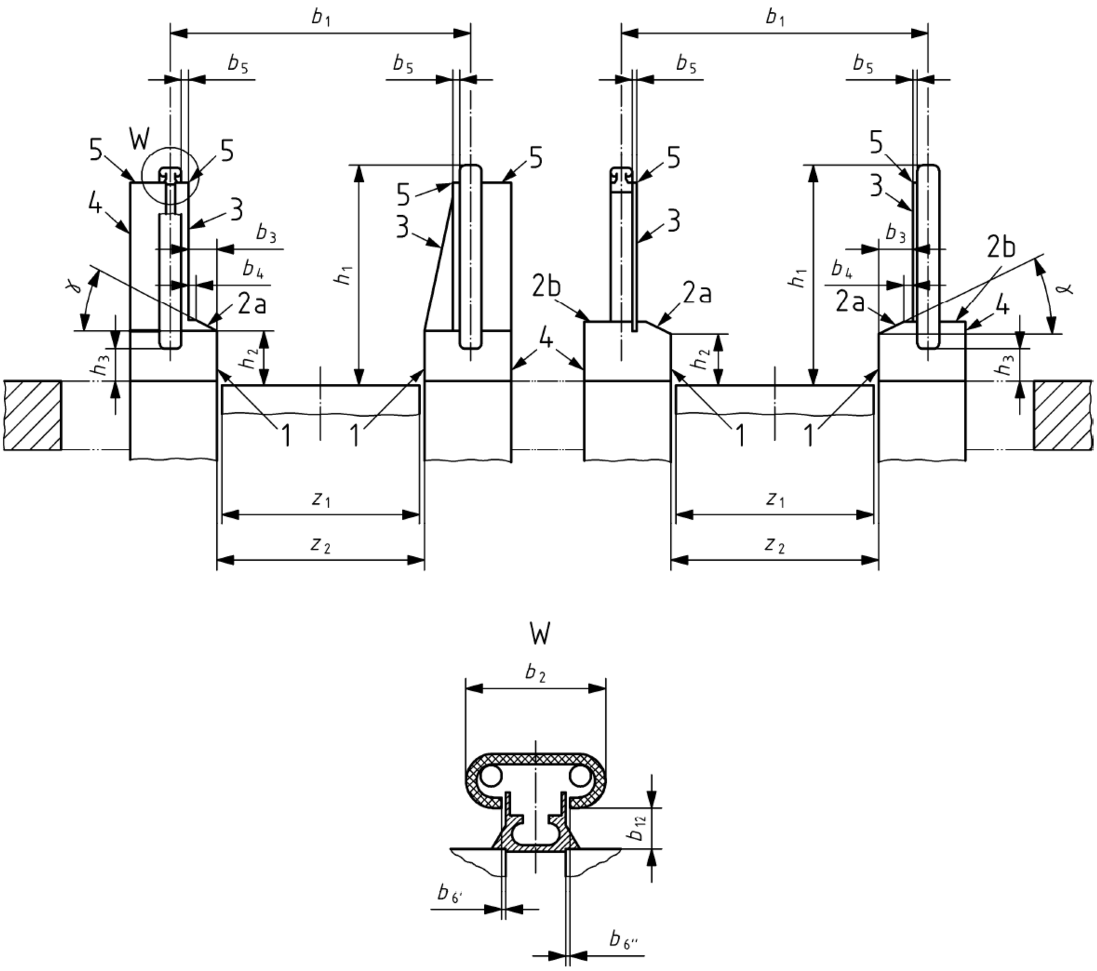
5.8.2.3 Where the main drive or brake is arranged between the user side of the step, pallet or belt and the return line, a level standing area in the working zone of not less than 0.12 m^2 shall be provided. The minimum dimension shall be not less than 0.30 m.

This standing area is permitted to be fixed or removable.



Principal Dimensions	Clause	Principal Dimensions	Clause
b_7 5 mm to 7 mm (step treads and pallets)	5.3.2.2.5	$h_8 \geq$ 4 mm	5.7.3.3.1
b_7 4.5 mm to 7 mm (belts)	5.3.2.3.2	h_{13} Rise	–
b_8 2.5 mm to 5 mm (step treads and pallets)	5.3.2.2.7	L_1 Root of comb teeth	–
b_8 4.5 mm to 8 mm (belts)	5.3.2.3.4	L_2 Comb intersection line	–
h_1 0.90 m to 1.10 m	5.5.2.1	l_1 Distance between supports	–
h_3 0.10 m to 0.25 m	5.6.4.1	$l_2 \geq$ 0.60 m	5.5.4.1
$h_4 \geq$ 2.30 m	Table 1	$l_3 \geq$ 0.30 m	5.5.4.2
$h_5 \geq$ 0.30 m	Table 1	$l_4 \geq$ 0.30 m	5.6.4.2
$h_6 \leq$ 4 mm	5.7.3.3.2	α Angle of inclination	–
$h_7 \geq$ 10 mm (step treads and pallets)	5.3.2.2.6	$\beta \leq 35$□	5.7.3.2.3
$h_7 \geq$ 5 mm (belts)	5.3.2.3.3		
NOTE — This figure has not been drawn to scale. It only serves to illustrate the requirements			

Fig. 2 Escalator (Elevation), Principal Dimensions



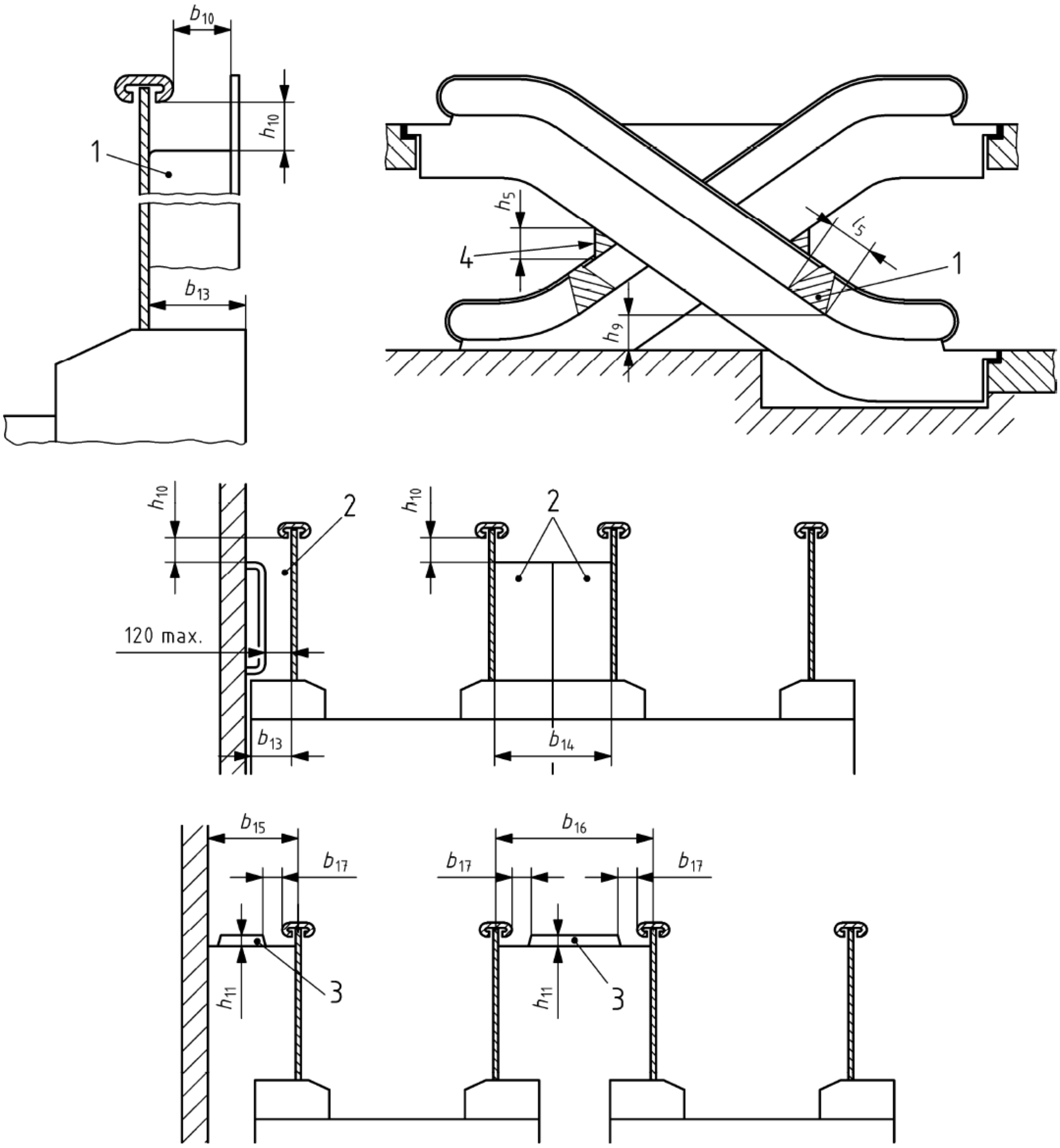
Legend

1	skirting (5.5.3)	3	interior panel (5.5.2.4)
2a	lower inner decking (5.5.2.6)	4	exterior panel (5.2.1.2)
2b	lower outer decking (5.5.2.2)	5	balustrade decking (5.5.2.2)

Principle Dimensions	Clause	Principle Dimensions	Clause
b_1 $\leq z_2 + 0.45$ m	5.6.3	$b_6' + b_6'' \leq 8$ mm	5.6.2.1
b_2 70 mm to 100 mm	5.6.2.2	b_{12} ≥ 25 mm	Table 1
b_3 < 0.12 m (if γ less than 45 °)	5.5.2.6.2	h_1 0.90 m to 1.10 m	5.5.2.1
b_4 < 30 mm	5.5.2.6.1	h_2 ≥ 25 mm	5.5.3.2
b_5 ≤ 50 mm	5.6.2.3	h_3 0.10 m to 0.25 m	5.6.4.1
z_2 $= z_1 + 7$ mm; distance between skirting	5.5.5.1	$\gamma \geq 25°$	5.5.2.6

NOTE — The Figure has not been drawn to scale. It only serves to illustrate the requirements.

FIG. 3 ESCALATOR/MOVING WALK (SECTIONAL VIEW), PRINCIPAL DIMENSIONS



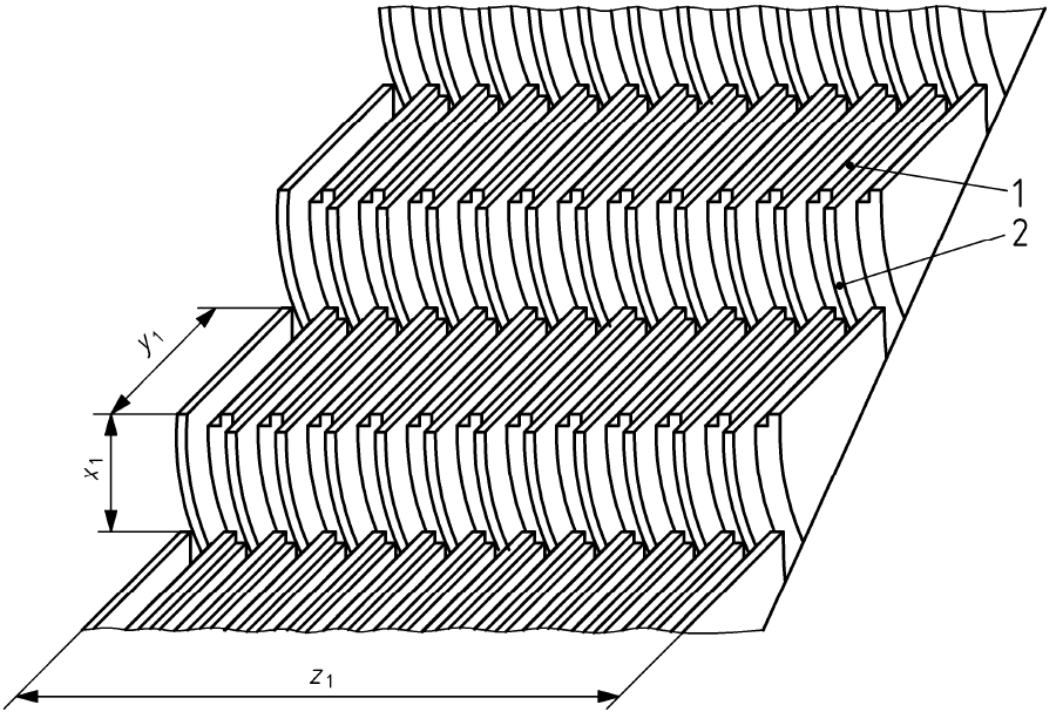
Legend

1	anti-climbing device (5.5.2.2)	3	anti-slide device (5.5.2.2)
2	access resistance device (5.5.2.2)		

Principle Dimensions	Clause	Principle Dimensions	Clause
b_{13}, b_{14}, b_{15}, b_{16}	5.5.2.2	h_9 = (1000 ± 50) mm	5.5.2.2
$b_{10} \geq 80$ mm	5.5.2.2	h_{10} = 25 mm to 150 mm	5.5.2.2
$b_{17} \geq 100$ mm	5.5.2.2	$h_{11} \geq 20$ mm	5.5.2.2
$h_5 \geq 0.30$ m	–	$l_5 \geq 1000$ mm	5.5.2.2

NOTE — The Figure has not been drawn to scale. It only serves to illustrate the requirements.

FIG. 4 ANTI-MISUSE DEVICES



Legend

1	step treads
2	step risers

Principle dimensions	Clause
$x_1 \leq 0.24$ m	5.3.2.2.1
$y_1 \geq 0.38$ m	5.3.2.2.2
z_1 0.58 m to 1.10 m	5.3.2.1

NOTE — The Figure has not been drawn to scale. It only serves to illustrate the requirements.

FIG. 5 STEPS, PRINCIPAL DIMENSIONS

Dimensions in millimetres

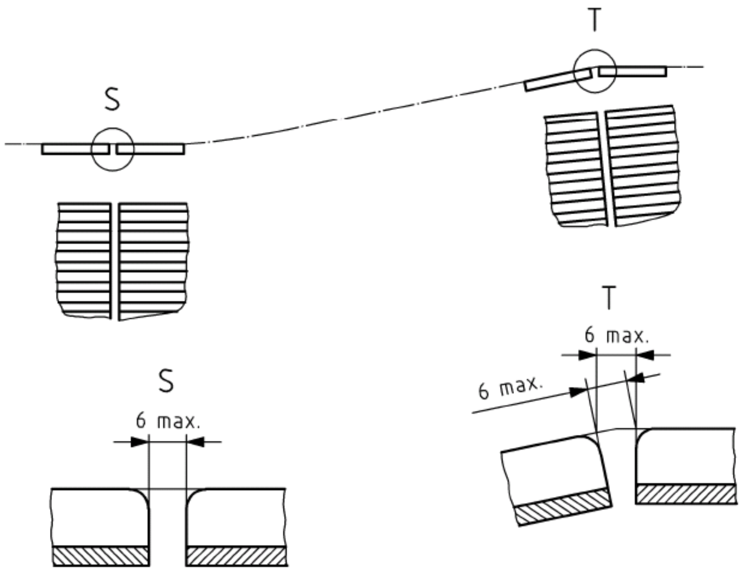


FIG. 6 PALLETS, CLEARANCE AND MESH DEPTH (PALLET TYPE MOVING WALK WITHOUT MESHED FRONT AND REAR EDGES) IN LOWER AND UPPER LANDING AND TRANSITION CURVES

Dimensions in millimetres

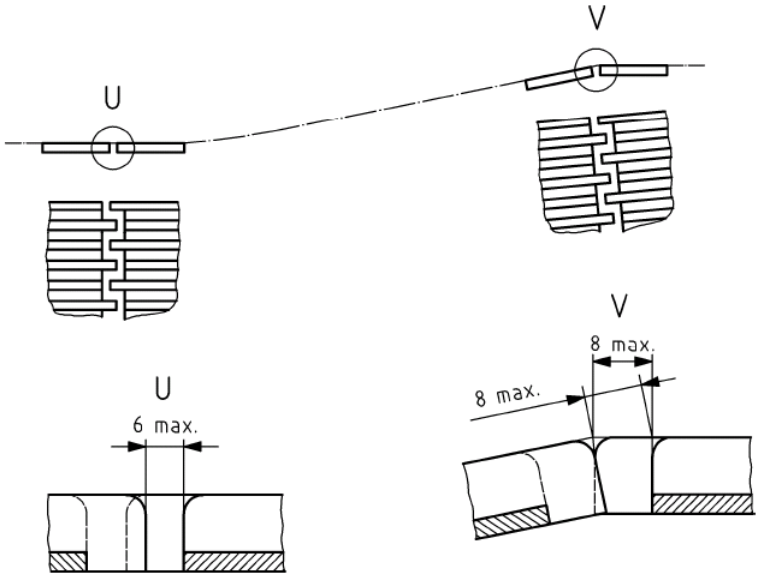
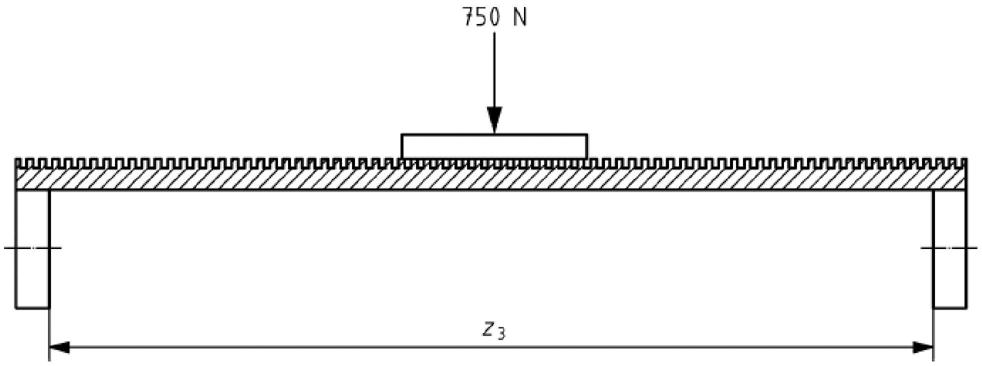


FIG. 7 PALLETS, CLEARANCE AND MESH DEPTH (PALLET TYPE MOVING WALK WITHOUT MESHED FRONT AND REAR EDGES) IN LOWER AND UPPER LANDING AND TRANSITION CURVES



Symbol for quantity/Designation	Clause
z_3 Transverse distance between the supporting rollers	5.3.3.2.4

NOTE — The Figure has not been drawn to scale. It only serves to illustrate the requirements.

FIG. 8 BELT (SECTIONAL VIEW), SINGLE FORCE

5.8.3 *Lighting and Socket Outlets*

5.8.3.1 The electric lighting and the socket outlets shall be independent of the power supply to the machine being fed either by a separate cable or a branch cable which is connected before the main switch of the escalator or moving walk. It shall be possible to break the supply of all phases by means of a separate switch (*see* **5.11.4.1**).

5.8.3.2 Electric lighting installations in driving and return stations and machinery spaces inside the truss shall be by means of a portable lamp permanently available in one of these places. One or more socket outlets shall be provided in each of these places.

The light intensity shall be at least 200 lx in working areas.

5.8.3.3 *Socket outlets shall be*

a) either of 3 pin type (2 poles + earth conductor), 250 V, directly supplied by the mains, or

b) of a type that is supplied at a safety extra low voltage in accordance with IS 9409.

5.8.4 *Maintenance and Repair Stop Switch*

There shall be a stop switch in the driving and return station.

Escalators and moving walks with the driving unit arranged between the user side of the step, pallet or belt and the return line, or outside the return stations, shall have additional stop switches in the area of the driving unit.

The operation of these stop switches shall cause the disconnection of the power supply from the driving machine and allow the operational brake to become effective to stop the escalator or moving walk.

When activated it shall prevent the escalator or moving walk from starting.

The switching positions shall be marked clearly and permanently.

SPECIFIC CASE — A stop switch need not be provided in a machinery space if a main switch according to **5.11.4** is located therein.

5.9 Fire Protection

Fire protection and building requirements differ from country to country and so far neither has been harmonized.

Therefore, this standard cannot include specific requirements for fire protection and building requirements.

However, it is recommended that as far as possible, escalators and moving walks are made of materials that do not create an additional hazard in case of fire.

Outer and inner decking, truss, pallets/steps, track system shall be according to class 3 of IS 12777.

5.10 Transportation

Complete escalators/moving walks or sub-assemblies or components of escalators/moving walks which cannot be handled by hand shall:

a) either be equipped with fittings for movement by a lifting device or transportation means;

b) be designed in a way that such fittings can be attached (for example, threaded holes); and

c) be shaped in a way that the lifting device or transportation means can be attached easily.

5.11 Electric Installations and Appliances

5.11.1 *General*

5.11.1.1 *Introduction*

The electric installation of escalators or moving walks shall be so designed and manufactured as to ensure protection against hazards arising from the electric equipment or which may be caused by external influences on it, provided the equipment is used in applications for which it was made and is adequately maintained.

Therefore, the electric equipment shall comply with the requirements of *Indian Electricity Act* and Rules.

5.11.1.2 *Limits of application*

5.11.1.2.1 The requirements of this standard relating to the installation and to the constituent components of the electric equipment apply to the:

a) main switch of each independent power circuit (for example, machine, heating system) of the escalator or moving walk and dependent circuits; and
b) switch for the lighting circuit of the escalator or moving walk and dependent circuits.

The escalator or moving walk shall be considered as a whole, in the same way as a machine with its incorporated apparatus.

5.11.1.2.2 The electricity supply to the input terminals of the switches referred to in **5.11.1.2.1** and the electricity supply to the lighting of the machinery spaces, driving and return stations are not laid down by this standard.

5.11.1.2.3 The electromagnetic compatibility shall comply with the requirements of IS 14700 (Part 4/Sec 1) and IS 14700 (Part 6/Sec 3).

5.11.1.3 *Protection against direct contact*

For protection against direct contact the requirements of IS 732 shall apply.

5.11.1.4 *Insulation resistance tests*

The insulation resistance measured at 500 V d. c. between the power circuit conductors and the protective bonding circuit shall be not less than 1 MΩ. The test may be made on individual sections of the complete electrical installation.

5.11.1.5 *Voltage limit for control and safety circuits*

For control and safety circuits, the value in direct current or the r.m.s value in alternating current between conductors or between conductors and earth shall not exceed 250 V.

5.11.1.6 *Conductor for neutral and earth-continuity*

The earth-continuity conductor shall be in accordance with IS 3043.

5.11.2 *Contactors, Relay Contactors, Components of Fail Safe Circuits*

5.11.2.1 *Contactors and relay contactors*

5.11.2.1.1 To stop the driving machine (*see* **5.12.1.2.4**) the main contactors shall belong to the following categories as defined in IS/IEC 60947-4-1:

a) AC-3 for contactors of alternating current motors; and
b) DC-3 for contactors of direct current machines.

5.11.2.1.2 Relay contactors (*see* **5.12.1.2.4**) shall belong to the following categories as defined in IS/IEC 60947-5-1:

a) AC-15 for contactors in alternating current control circuits; and
b) DC-13 for contactors in direct current control circuits.

5.11.2.1.3 For both, the main contactors (*see* **5.11.2.1.1**) and the relay contactors (*see* **5.11.2.1.2**) it is permissible to assume, in the measures taken to comply with **5.12.1.1.2**, that:

a) if one of the break contacts (normally closed) is closed, all the make contacts are open; and
b) if one of the make contacts (normally open) is closed, all the break contacts are open.

5.11.2.2 *Components of fail-safe circuits*

5.11.2.2.1 When devices according to **5.11.2.1.2** are used as relays in a fail-safe circuit, the assumptions of **5.11.2.1.3** also apply.

5.11.2.2.2 If the relays used are such that the break and make contacts are never closed simultaneously for any position of the armature, the possibility of partial attraction of the armature is permitted to be disregarded (*see* **5.12.1.1.2** f).

5.11.2.2.3 Devices connected after electric safety devices shall meet the requirements of **5.12.1.2.2.3** with regard to the creep distances and air gaps (not with regard to the separation distances).

This requirement does not apply to the devices mentioned in **5.11.2.1.**

5.11.3 *Protection of Motors*

5.11.3.1 Motors directly connected to the mains shall be protected against short-circuiting.

5.11.3.2 Motors directly connected to the mains shall be protected against overload by means of automatic circuit breakers with manual reset (except as provided for in **5.11.3.3**) which shall cut off the supply to the motor in all live conductors (*see* IS/IEC 60947-4-1).

5.11.3.3 When the detection of overload operates on the basis of temperature increase in the windings of the motor, the protection device is permitted to close its contact automatically after sufficient cooling down has taken place; however, it shall only be possible to restart the escalator or moving walk under the conditions of **5.12.2.1**.

5.11.3.4 The provisions of **5.11.3.2** and **5.11.3.3** apply to each winding if the motor has windings supplied by different circuits.

5.11.3.5 When the escalator or moving walk driving motors are supplied by d.c. generators driven by motors, the generator driving motors shall also be protected against overload.

5.11.4 *Main Switches*

5.11.4.1 In the vicinity of the machine or in the return stations, or in the vicinity of the control devices, there shall be a main switch capable of breaking the supply to the motor, to the brake releasing device and to the control circuit in the live conductors.

This switch shall not cut the supply to the socket outlets or to the lighting circuits necessary for inspection and maintenance (*see* **5.8.3**).

When separate supplies are provided for auxiliary equipment, such as, heating, balustrade lighting and comb lighting, it shall be possible to switch them off independently. The corresponding switches shall be located close to the main switch and be marked unambiguously.

5.11.4.2 The main switches as defined in **5.11.4.1** shall be capable of being locked or otherwise secured in the "isolated" position, with the use of a padlock or equivalent, to ensure no inadvertent operation by others. The control mechanism of the main switch shall be easily and rapidly accessible after opening of the doors or trap doors.

5.11.4.3 The main switches shall be capable of interrupting the highest current involved in normal operating conditions of escalator or moving walk. They shall comply with the requirements of IS 732.

5.11.4.4 Where the main switches of several escalators or moving walks are positioned together it shall be possible to easily identify to which escalator or moving walk they refer.

5.11.5 *Electric Wiring*

5.11.5.1 *General*

5.11.5.1.1 Cables shall be selected from those standardized by IS and of a quality at least equivalent to that defined by the standards mentioned in **5.11.5.1.2** to **5.11.5.1.4**.

5.11.5.1.2 Conductors, such as, those in conformity with IS 694, are permitted only in conduits, ducting, or similar fittings ensuring equivalent protection. When deviating from IS 694, the nominal cross-sectional area of the conductors shall be not less than 0.75 mm^2.

5.11.5.1.3 Rigid sheathed cables, such as, those in conformity with IS 694, are permitted only in visible mountings fixed to the walls, or in conduits, ducting or similar fittings.

5.11.5.1.4 Ordinary flexible cables, such as, those in conformity with IS 694 are permitted only in conduits, ducting or similar fittings ensuring equivalent protection within the truss where it is not vulnerable to accidentally damage.

Flexible cables with thick sheath, such as, those in conformity with IS 9968 (Part 1), elastomer insulated cables are permitted to be installed rigidly in conditions defined in **5.11.5.1.3** and for connection to a movable appliance or if they are subject to vibrations

5.11.5.1.5 The requirements of **5.11.5.1.2**, **5.11.5.1.3** and **5.11.5.1.4** need not apply to the wiring of control or distribution devices in control cabinets or on control panels:

a) either between different pieces of electric equipment, or
b) between these pieces of equipment and the connection terminals.

5.11.5.2 *Cross-sectional area of conductors*

In order to provide mechanical strength, the cross-sectional area of the conductors of safety circuits shall not be less than 0.75 mm^2.

5.11.5.3 *Method of installation*

5.11.5.3.1 The electric installation shall be provided with the indications necessary to make it easy to understand.

5.11.5.3.2 If, after the opening of the main switch or switches of the escalator or moving walk, some connection terminals remain live, they shall be clearly separated from terminals which are not live, if the voltage exceeds 50 V, they shall be suitably marked.

In these instances, the requirements of IS 732 apply.

5.11.5.3.3 In order to ensure continuity of mechanical protection, the protective enclosures of cables shall enter the casings of switches and appliances, or shall have proper glands at their ends.

5.11.5.4 *Connectors*

Connectors and devices of the plug-in type which are safety related and which can be extracted without the use of a tool shall be designed in such a way that it is impossible to re-insert them incorrectly.

5.11.6 *Connecting Terminals*

Connection terminals, an accidental interconnection of which could lead to a dangerous situation of the escalator or moving walk, shall be clearly separated.

5.11.7 *Protection against Electrostatic Loading*

Means to discharge electrostatic loading shall be provided (for example, brushes).

5.12 Protection against Electric Faults-controls

5.12.1 *Protection against Electric Faults*

5.12.1.1 *General*

5.12.1.1.1 Any single fault listed in **5.12.1.1.2** in the electric equipment of an escalator or moving walk, if it cannot be excluded under conditions described in **5.12.1.1.3**, shall not, on its own, be the cause of a dangerous situation of the escalator or moving walk.

5.12.1.1.2 The following faults shall be envisaged:

a) absence of voltage;
b) voltage drop;
c) loss of continuity of a conductor;
d) fault to earth of a circuit;
e) short circuit or open circuit, change of value or function in an electric component such as resistor, capacitor, transistor, lamp;
f) non-attraction or incomplete attraction of the moving armature of a contactor or relay;
g) non-separation of the moving armature of a contactor or relay;
h) non-opening of a contact;
j) non-closing of a contact; and
k) phase reversal.

5.12.1.1.3 The non-opening of a contact need not be considered in the case of safety switches conforming to **5.12.1.2.2.**

5.12.1.1.4 The fault to earth of a circuit in which there is an electric safety device shall cause the immediate stopping of the driving machine (*see* Table 6 xvi).

5.12.1.2 *Electric safety devices*

5.12.1.2.1 *General requirements*

5.12.1.2.1.1 The electric safety devices for the events listed in Table 6 shall prevent the driving machine from starting or cause the immediate stopping of the driving machine according to **5.12.1.2.4** and consist of:

a) either one or more safety switches satisfying **5.12.1.2.2** directly disconnecting the supply to the contactors or their relay contactors, or
b) fail safe circuits satisfying **5.12.1.2.3** consisting of:
    1) either one or more safety switches satisfying **5.12.1.2.2** not directly disconnecting the supply to the contactors or their relay contactors, or
    2) or contacts not satisfying the requirements of **5.12.1.2.2**.

5.12.1.2.1.2 No electric equipment shall be connected in parallel with an electric safety device with the exception of:

a) electric safety devices in case of inspection mode (**5.12.2.5**); and
b) connections to different points of the safety circuit for information about the status of electric safety devices.

5.12.1.2.1.3 The effects of internal or external inductance or capacitance shall not cause failures of fail-safe circuits.

5.12.1.2.1.4 An output signal emanating from a fail-safe circuit shall not be altered by an extraneous signal emanating from another electric device placed further down the same circuit, which would cause a dangerous condition to result.

5.12.1.2.1.5 The construction and arrangement of the internal power supply units shall be, such as, to prevent the appearance of false signals at the outputs of electric safety devices due to the effects of switching.

In particular, voltage peaks arising from the operation of the escalator, moving walk or other equipment on the network shall not create inadmissible disturbances in electronic components (noise immunity) in compliance with IS 14700 (Part 6/Sec 3) and IS 14700 (Part 4/Sec 1).

5.12.1.2.2 *Safety switches*

5.12.1.2.2.1 The operation of a safety switch shall be by positive mechanical separation of the contacts.

This positive mechanical separation shall even occur if the contacts are welded together.

Positive mechanical separation is achieved when all contacts are brought to their open position in such a way that for a significant part of the travel there are no resilient elements (for example, springs) between the moving contacts and the part of the actuator to which the actuating force is applied.

The design shall be such as to minimize the risk of a short-circuit resulting from a faulty component.

5.12.1.2.2.2 The safety switch shall be provided for a rated insulation voltage of 250 V if the enclosure provides a degree of protection of at least IP 4X (in accordance with IS/IEC 60529), or 500 V if the degree of protection of the enclosure is less than IP 4X.

Safety switches shall belong to the following categories as defined in IS/IEC 60947-5-1:

a) AC-15 for safety switches in alternating current circuits; and

b) DC-13 for safety switches in direct current circuits.

5.12.1.2.2.3 If the protective enclosure is not at least of type IP 4X the air gaps shall be at least 3 mm and creep distances at least 4 mm.

After separation the distance for contacts shall be at least 4 mm.

5.12.1.2.2.4 In the case of multiple breaks, the individual distances for breaking contacts shall be at least 2 mm after separation.

5.12.1.2.2.5 Debris from the conductive material shall not lead to short-circuiting of contacts.

5.12.1.2.3 *Fail safe circuits*

5.12.1.2.3.1 Anyone of the faults envisaged in **5.12.1.1** shall not be on its own the cause of a dangerous situation.

5.12.1.2.3.2 Furthermore, the following conditions apply for the faults envisaged in **5.12.1.1**:

a) If one fault combined with a second fault can lead to a dangerous situation, the escalator or moving walk shall be stopped by the time the next operating sequence takes place in which the faulty element should participate.

b) The possibility of the second fault leading to a dangerous situation before the escalator or moving walk has been stopped by the sequence mentioned, is not considered.

c) If the malfunction of the component which has caused the first fault cannot be detected by a change of state, appropriate measures shall ensure that the fault is detected and movement prevented at the latest when the escalator or moving walk is restarted according to **5.12.2.4**.

d) The MTBF (mean time between failures) of the fail-safe circuit shall be at least 2.5 years. This time was determined under the assumption that within a period of three months each escalator or each moving walk is restarted according to **5.12.2.4** at least once and, thus, is subject to a change of state.

5.12.1.2.3.3 If two faults combined with a third fault can lead to a dangerous situation, the escalator or moving walk shall be stopped by the time the next operating sequence takes place in which one of the faulty elements should participate.

The possibility of the third fault leading to a dangerous situation before the escalator or moving walk has been stopped by the sequence mentioned, is not considered.

If the malfunction of the components which have caused the two faults cannot be detected by a change of state, appropriate measures shall ensure that the faults are detected and movement is prevented at the latest when the escalator or moving walk is restarted according to **5.12.2.4**.

The MTBF (mean time between failures) of the fail-safe circuit shall be at least 2.5 years. This time was determined under the assumption that within a period of three months each escalator or each moving walk is restarted according to **5.12.2.4** at least once and, thus, is subject to a change of state.

5.12.1.2.3.4 A combination of more than three faults can be disregarded if:

a) the fail-safe circuit is built up of at least two channels, and their equal status is monitored by a control circuit. The control circuit shall be checked prior to a restart of the escalator or moving walk according to **5.12.2.4**, or

b) the fail-safe circuit is built-up of at least three channels, and their equal status is monitored by a control circuit.

If the requirements of a) or b) are not fulfilled, it is not permitted to interrupt the failure analysis but it shall be continued analogous to **5.12.1.2.3.3**.

5.12.1.2.4 *Operation of electric safety devices*

When operated, an electric safety device shall prevent the setting in motion of the driving machine or immediately initiate its stopping. The operational brake shall be activated.

5.12.1.2.5 *Actuation of electric safety devices*

The components actuating the electric safety devices shall be selected and assembled so that they are able to function properly even under the mechanical stresses resulting from its continuous operation.

In the case of redundancy type fail safe circuit, it shall be ensured by mechanical or geometric arrangements of the transmitter elements that a mechanical fault cannot cause unnoticed loss of redundancy.

5.12.2 *Controls*

5.12.2.1 *Starting and making available for use the escalator or moving walk*

5.12.2.1.1 Starting of the escalator or moving walk (or making it available for use when starting is automatic by a user passing a certain point) shall be effected by one or more switches available to authorized persons only (for example, key-operated switches, switches with detachable lever, switches under lockable protective caps, remote start devices) and be reachable from an area outside the comb intersection line. Such switches shall not function concurrently as main switches described in **5.11.4**. The person who operates the switch shall either be able to see the entire escalator or entire moving walk or shall have means of ensuring that nobody is using the escalator or moving walk before making this operation. The direction of travel shall be distinctly recognizable from the indication on the switch.

Any one of the faults envisaged in **5.12.1.1.2** in the electric equipment of the escalator or moving walk, if it cannot be excluded under conditions described in **5.12.1.1.3**, shall not cause a start of the machine.

The starting switch(es) shall be located within reach of a stop switch according to **5.12.2.2.3.2**.

For remote starting devices the requirements above shall apply.

NOTE — *See* **7.1** e) of IS 4591 (Part 1/Sec 2) for the obligation of the maintainer to observe a complete revolution of the step/pallet band before making the escalator/moving walk available to the public after maintenance.

5.12.2.1.2 Escalators or moving walks which start or accelerate automatically by the entering of a user (stand-by operation) shall move with at least 0.2 times the nominal speed when the person reaches the comb intersection line and then accelerate less than 0.5 m/s².

NOTE — An average speed for a walking person of 1 m/s should be taken into account.

The requirements of **5.12.1.1** shall be met.

Constructional measures may be necessary to prevent circumvention of the control elements.

5.12.2.1.3 On escalators or moving walks which start automatically by the entering of a user, the direction of travel shall be predetermined, clearly visible to the user and marked distinctly on the escalator/moving walk (*see* **7.2.2**).

In such cases where escalators or moving walks which start automatically by the entering of a user can be entered in the direction opposite its predetermined direction of travel, they shall start in the predetermined direction and conform to the requirements of **5.12.2.1.2**. The running time shall be not less than 10 s.

5.12.2.2 *Stopping*

5.12.2.2.1 *Stopping by operator, manually operated*

Before stopping, the person shall have means of ensuring that nobody is using the escalator or moving walk, before making this operation. For remote stopping devices the same requirements apply.

5.12.2.2.2 *Stopping, automatically operated*

It is permitted to design the control in such a way that the escalator or moving walk is stopped automatically after a sufficient time (at least the anticipated user transfer time plus 10 s) after the user has actuated a control element described in **5.12.2.1.2**.

5.12.2.2.3 *Stop switch for emergency situations, manually operated*

5.12.2.2.3.1 Stop switch for emergency situations shall be provided to stop the escalator or moving walks in the event of an emergency. They shall be placed in conspicuous and easily reachable positions at least at or near each landing of the escalator or moving walk (*see* **7.2.1.2.2** for optimal design).

The distances between stop switches for emergency situations shall not exceed:

a) 16 m on escalators; and
b) 40 m on moving walks.

If necessary, additional stop switches shall be provided to maintain the distance. The use of suitably designed shopping trolleys and baggage carts on moving walks is permitted. Shopping trolleys and baggage carts which are chosen for use on a moving walk shall be specified between the baggage cart manufacturer and the moving walk manufacturer.

5.12.2.2.3.2 Stop switch for emergency situations shall be electric safety devices according to **5.12.1.2**.

5.12.2.2.4 *Stopping initiated by monitoring or electric safety devices* (*see* **5.12.1.2.1.1**)

5.12.2.2.4.1 In case of any event detected by a monitoring or electric safety device as listed in Table 6 the driving machine shall be prevented from starting or shall be stopped immediately before a restart procedure (*see* **5.12.2.4**).

References to the relevant requirements for each monitoring and electric safety device are given in Table 6.

5.12.2.2.4.2 Switching-off operations performed by monitoring and electric safety devices listed under xi) to xiv) of Table 6 may also be performed by safety switches (**5.12.1.2.2**) or fail safe circuits (**5.12.1.2.3**).

5.12.2.3 *Reversal of direction of travel*

An intended reversal of the direction of travel shall be possible only if the escalator or moving walk stands still and **5.12.2.1, 5.12.2.1.2, 5.12.2.1.3** and **5.12.2.2.2** are complied with.

5.12.2.4 *Restarting*

5.12.2.4.1 *Restarting by switch*

After each stop (**5.12.2.2.1, 5.12.2.2.3, 5.12.2.2.4**) except the one mentioned in **5.12.2.2.2**, restarting shall be possible only by means of the switches mentioned in **5.12.2.1** or by means of the inspection control described in **5.12.2.5**. It shall be observed that where stopping is effected in the cases as listed in i), iii), v), x), xi), xii), xv), xvi) and xvii) of Table 6, restarting

Table 6 Requirements for Monitoring and Electric Safety Device

(*Clauses* 5.2.1.6, 5.2.4, 5.3.3.1, 5.3.5, 5.3.6, 5.4.1.4, 5.4.2.1.1.1, 5.4.2.1.3.4, 5.4.2.3, 5.4.3.3, 5.6.1, 5.6.4.3, 5.7.2.5, 5.7.3.2.6, 5.12.1.1.4, 5.12.1.2.1.1, 5.12.2.2.4, 5.12.2.4.1 *and* 5.12.2.5.4)

Sl No. (1)	**Event to be Detected** (2)	**Requirement** **(3)**
i)	Overload (by means of automatic circuit breakers); starting shall be prevented (*see* also **5.12.2.4.1**)	**5.11.3.2**
ii)	Overload (operated on basis of temperature increase)	**5.11.3.3**
iii)	Excessive speed or unintentional reversal of the direction of travel (according to **5.4.2.3**); starting shall be prevented (*see* also **5.12.2.4.1**)	**5.12.1.2.2** or **5.12.1.2.3**
iv)	Closing of the auxiliary brake (according to **5.4.2.2.4**)	**5.12.1.2.2** or **5.12.1.2.3**
v)	Breakage or undue elongation of parts immediately driving the steps, pallets or the belt, for example chains or racks, starting shall be prevented (*see* also **5.12.2.4.1**)	**5.12.1.2.2** or **5.12.1.2.3**
vi)	(Unintended) extension or reduction of the distance between the driving and return devices	**5.12.1.2.2** or **5.12.1.2.3**
vii)	Foreign bodies being trapped at the point where the steps, pallets or the belt enter the comb (according to **5.7.3.2.6**)	**5.12.1.2.2** or **5.12.1.2.3**
viii)	Stopping of a succeeding escalator or moving walk where an intermediate exit does not exist (*see* IS 4591 (Part 1/Sec 2) clause 6.2.6) or the exit of the escalator or moving walk by structural measures is blocked (for example, shutters, fire protection gates)	**5.12.1.2.2** or **5.12.1.2.3**
ix)	Foreign bodies being trapped in the handrail entry (*see* **5.6.5.3**)	**5.12.1.2.2** or **5.12.1.2.3**
x)	Sagging of step or pallet (*see* **5.7.2.5**); starting shall be prevented (*see* also **5.12.2.4.1**); Paragraph j) does not apply to belt moving walks (*see* **5.7.2.5**)	**5.12.1.2.2** or **5.12.1.2.3**
xi)	Missing step/pallet (*see* **5.3.6**); starting shall be prevented (*see* also **5.12.2.4.1**)	**5.3.6** or **5.12.2.4.1**
xii)	Non-lifting of the braking system after starting the escalator or moving walk (*see* **5.4.2.1.1**); starting shall be prevented (*see* also **5.12.2.4.1**)	**5.4.2.1.1** or **5.12.2.4.1**
xiii)	Hand rail speed deviation of more than -15 percent to the actual speed for more than 15 s (*see* **5.6.1**)	**5.6.1**
xiv)	Opened inspection cover in the area of the truss and/or removed or opened floor plate (*see* **5.2.4**)	**5.2.4**
xv)	Maximum permitted stopping distances exceeded by more than 20 percent (*see* **5.4.2.1.1**); starting shall be prevented	**5.12.2.4.1**
xvi)	Fault to earth of a circuit in which there is an electric safety device; starting shall be prevented (*see* also **5.12.1.1.4**)	**5.12.2.4.1**
xvii)	Installation of a removable hand winding device (*see* **5.4.1.4**)	**5.4.1.4**

shall be possible only after the failure lock has been manually reset.

Before manual reset the root cause for stopping has to be investigated, the stopping device has to be checked and corrective action has to be taken if necessary.

The failure lock shall remain active even following failure or reinstatement of the power supply.

5.12.2.4.2 *Reactivation for automatic restart*

Where stopping is effected by a stop switch for emergency situation according to **5.12.2.2.3**, reactivation of the escalator or moving walk for automatic restart without the switches mentioned in **5.12.2.1** is permitted under the following conditions:

a) The steps, pallets or the belt shall be supervised between the comb intersection lines and additional 0.30 m beyond each comb so that reactivation for automatic restart is effected only when there is no person or object within this zone.

   The device shall be able to detect an opaque upright standing cylinder with a diameter of 0.30 m and a height of 0.30 m at any place within this zone.

b) The escalator or moving walk shall start by the entering of a user according to **5.12.2.1.2**.

   Starting shall be effected only if, for a period of at least 10 s, the control device has not detected any persons or objects within the defined zone.

c) The reactivation control initiated by the control device for automatic restart shall be an electric safety device according to **5.12.1.2**. Self-controlling transmitter elements are permitted in single-channel design.

5.12.2.5 *Inspection control*

5.12.2.5.1 Escalators or moving walks shall be equipped with inspection controls to permit operation during maintenance, repair or inspection by means of portable and manually operated control devices.

5.12.2.5.2 For this purpose, one inspection outlet for the connection of the flexible cable of the portable manually operated control device shall be provided at least at each landing, for example, in the driving station and the return station in the truss. The length of the cable shall be at least 3.0 m. Inspection outlets shall be located in such a way that any point of the escalator or moving walk can be reached with the cable.

5.12.2.5.3 The operating elements of this control device shall be protected against accidental operation. The escalator or moving walk is permitted to run only as long as the operating elements are switched on by permanent application of manual pressure. The direction of travel shall be distinctly recognizable from the indication on the switch. Each control device shall have a stop switch.

The stop switch shall:

a) be operated manually;
b) have the switching positions marked clearly and permanently;
c) be a safety switch satisfying **5.12.1.2.2**;
d) require manual reset.

When the inspection control device is plugged in, the operation of the stop switch shall cause the disconnection of the power supply from the driving machine and the operational brake shall be activated.

5.12.2.5.4 When the inspection control device is used, all other starting devices shall be rendered inoperative in accordance with **5.12.1.2**.

All inspection outlets shall be arranged in such a way that when more than one control device is connected, they all become inoperative. The electric safety devices (according to **5.12.2.2.4**) shall remain effective with the exception of the electric safety devices mentioned in viii), x), xi), xii), xiii) and xiv) of Table 6.

6 VERIFICATION OF THE SAFETY REQUIREMENTS AND PROTECTIVE MEASURES

6.1 General

Table 7 indicates the methods by which the safety requirements and measures described in **5** shall be verified by the manufacturer for each new model of escalator/moving walk, together with a reference to the corresponding sub-clauses in this standard. Secondary sub-clauses, which are not listed in the table, are verified as part of the quoted sub-clause. All verification records shall be kept by the manufacturer.

Where mechanical testing is required in accordance with this standard, setting tolerances are permitted.

Table 7 Methods to be Used to Verify Conformity to the Requirements

(*Clause* 6.1)

Sl No.	Clause	Testing [a)]	Measurement [b)]	Calculation [c)]	Visual Inspection [d)]
(1)	**(2)**	(3)	(4)	(5)	(6)
i)	**5.2.1.1**				x
ii)	**5.2.1.2**			x	
iii)	**5.2.1.3**				x
iv)	**5.2.1.4**				x
v)	**5.2.1.5**				x
vi)	**5.2.2**		x		
vii)	**5.2.3**				x
viii)	**5.2.4**			x	x
ix)	**5.2.5**			x	
x)	**5.3.1**		x		
xi)	**5.3.2**		x		
xii)	**5.3.3**	x		x	
xiii)	**5.3.4**		x		
xiv)	**5.3.5**		x		
xv)	**5.4.1.1**				x
xvi)	**5.4.1.2**		x		

Table 7 (*Continued*)

Sl No.	**Clause**	**Testing** [a)]	**Measurement** [b)]	**Calculation** [c)]	**Visual Inspection** [d)]
(1)	**(2)**	(3)	(4)	(5)	(6)
xvii)	**5.4.1.3.1**				x
xviii)	**5.4.1.3.2**			x	
xix)	**5.4.1.4**				x
xx)	**5.4.1.5**	x			
xxi)	**5.4.2.1.1**	x			
xxii)	**5.4.2.1.2**	x			
xxiii)	**5.4.2.1.3.1**			x	
xxiv)	**5.4.2.1.3.2**		x		
xxv)	**5.4.2.1.3.3**			x	
xxvi)	**5.4.2.1.3.4**		x		
xxvii)	**5.4.2.2.1**				x
xxviii)	**5.4.2.2.2**			x	
xxix)	**5.4.2.2.3**				x
xxx)	**5.4.2.2.4**	x			
xxxi)	**5.4.2.2.5**	x			
xxxii)	**5.4.2.3**	x			
xxxiii)	**5.4.3.1**				x
xxxiv)	**5.4.3.2**			x	
xxxv)	**5.4.3.3**	x			x
xxxvi)	**5.4.4.1**			x	
xxxvii)	**5.4.4.2**				x
xxxviii)	**5.5.1**				x
xxxix)	**5.5.2.1**		x		
xl)	**5.5.2.2**		x		x
xli)	**5.5.2.3**			x	
xlii)	**5.5.2.4**		x		x
xliii)	**5.5.2.5**		x		
xliv)	**5.5.2.6**		x		
xlv)	**5.5.3.1**		x		
xlvi)	**5.5.3.2**		x		x
xlvii)	**5.5.3.3**	x			
xlviii)	**5.5.3.4**	x	x		
xlix)	**5.5.4**		x		
l)	**5.5.5**		x		x
li)	**5.6.1**	x	x		
lii)	**5.6.2.1**		x		
liii)	**5.6.2.2**		x		
liv)	**5.6.2.3**		x		
lv)	**5.6.3**		x		
lvi)	**5.6.4.1**		x		
lvii)	**5.6.4.2**		x		
lviii)	**5.6.4.3**				x
lix)	**5.6.5**				x
lx)	**5.7.1**	x	x		

Table 7 (*Continued*)

Sl No.	Clause	Testing [a]	Measurement [b]	Calculation [c]	Visual Inspection [d]
(1)	**(2)**	(3)	(4)	(5)	(6)
lxi)	**5.7.2.1**		x		
lxii)	**5.7.2.2**		x		
lxiii)	**5.7.2.3**		x		
lxiv)	**5.7.2.4**		x		
lxv)	**5.7.2.5**				x
lxvi)	**5.7.3.1**				x
lxvii)	**5.7.3.2.1**		x		x
lxviii)	**5.7.3.2.2**		x		x
lxix)	**5.7.3.2.3**		x		x
lxx)	**5.7.3.2.4**				x
lxxi)	**5.7.3.2.5**				x
lxxii)	**5.7.3.2.6**	x			
lxxiii)	**5.7.3.3**		x		
lxxiv)	**5.8.1**				x
lxxv)	**5.8.2.1**		x		
lxxvi)	**5.8.2.2**				x
lxxvii)	**5.8.3**		x		x
lxxviii)	**5.8.4**				x
lxxix)	**5.9**				x
lxxx)	**5.10**				x
lxxxi)	**5.11**	x	x		x
lxxxii)	**5.12**	x			x
lxxxiii)	**7**				x

Legend

[a] The result of the test is to show that the escalator/moving walk works as intended, including the electric safety devices

[b] The result of the measurement is to show that the stated measurable parameters have been met.

[c] Calculations will verify that the design characteristics of the provided components meet the requirements.

[d] The results of the visual inspections is only to show that something is present (e.g. a marking, a control panel, an instruction handbook), that the marking required satisfies the requirement and that the content of the documents delivered to the owner is in accordance with the requirements.

x Indicates "Required".

6.2 Specific Data, Test Reports and Certificates

The following documentation should be held by the manufacturer:

a) stress analysis of the truss or equivalent certificate by a stress analyst;
b) proof by calculation of sufficient breakage resistance of the parts directly driving the steps, pallets or the belt, for example, step chains, racks;
c) calculation of the stopping distances for loaded moving walks (*see* **5.4.2.1.3.4**) together with adjustment data;
d) proof testing of steps or pallets;
e) proof of the breaking strength of the belt;
f) proof of sliding coefficients for skirting;
g) proof of anti-slip properties of tread surfaces (steps, pallets, floor and comb plates without combs);
h) proof of stopping distances and deceleration values; and
j) proof of electromagnetic compatibility.

7 INFORMATION FOR USE

7.1 General

All escalators and moving walks are required to be provided with documentation that shall include an instruction handbook relating to use, maintenance, inspection, periodic checks and rescue operations.

Information for use shall cover, separately or in combination, transport, assembly and installation, commissioning, use (setting, teaching/programming, operation, cleaning, fault finding and maintenance) of the escalator and moving walk, and, if necessary, de-commissioning, dismantling and disposal.

7.2 Signals and Warning Devices

7.2.1 *Plates, Inscriptions and Notices for Use*

7.2.1.1 *General*

All signs, inscriptions and notices for use shall be of durable material, placed in a conspicuous position and written in clearly legible characters in the language of the country where the escalator or moving walk is in operation.

7.2.1.2 *Safety signs near the entrances of escalators or moving walks*

7.2.1.2.1 The following mandatory action signs and prohibition signs for the user shall be fixed in the vicinity of the entrances:

a) "Small children shall be held firmly" (*see* Fig. 9);
b) "Dogs shall be carried" (*see* Fig. 10);
c) "Use the handrail" (*see* Fig. 11); and
d) "Push chairs not permitted" (*see* Fig. 12).

When required by local conditions, prohibition signs, for example, "Transportation of bulky and heavy loads not permitted" and mandatory action signs like "Use permitted only with footwear" will possibly be necessary.

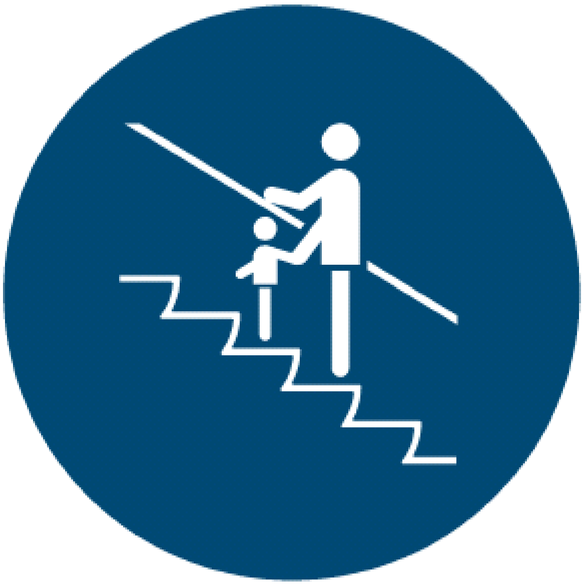


FIG. 9 MANDATORY ACTION SIGN "SMALL CHILDREN SHALL BE HELD FIRMLY"

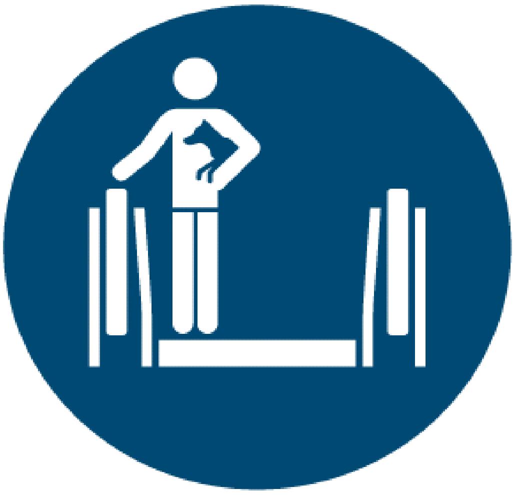


FIG. 10 MANDATORY ACTION SIGN "DOGS SHALL BE CARRIED"

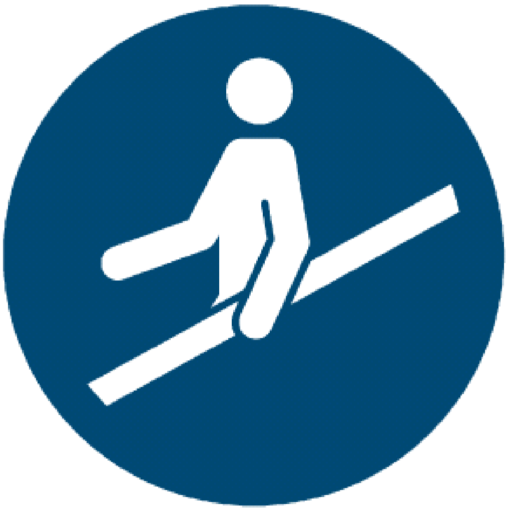


FIG. 11 MANDATORY ACTION SIGN "USE THE HANDRAIL"

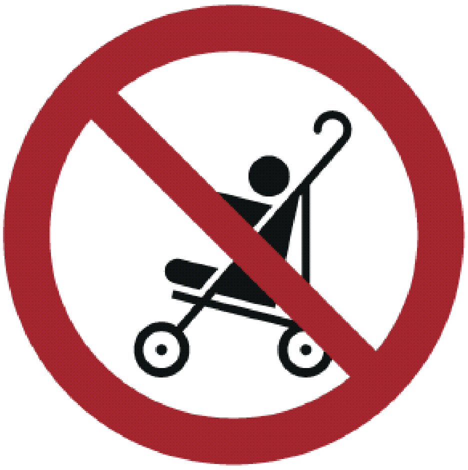


FIG. 12 PROHIBITION SIGN "PUSH CHAIRS NOT PERMITTED"

7.2.1.2.2 Stop devices referred to in **5.12.2.2.3** shall be coloured red and either on the device itself or in its immediate vicinity be marked with the inscription "STOP".

7.2.1.2.3 During maintenance, repair, inspection or similar work, the access to the escalator or moving walk shall be barred to unauthorized persons by devices:

a) which shall bear the notice "No Access", or
b) the "No Entry" indicator and be available in immediate area.

7.2.1.3 *Instructions for hand winding devices*

If a hand winding device is provided, operating instructions for use shall be available in the vicinity. The direction of travel of the escalator or moving walk shall be indicated clearly.

7.2.1.4 *Notices on the access doors to machinery spaces outside the truss, driving and return stations*

On access doors to machinery spaces outside the truss, driving and return stations, a notice shall be fixed with the inscription:

"Machinery space — danger, access prohibited to unauthorized persons".

7.2.2 *Special Indicators for Escalators and Moving Walks Starting Automatically*

In the case of escalators or moving walks starting automatically, a clearly visible signal system, for example, road traffic signals, shall be provided indicating to the user whether the escalator or moving walk is available for use, and its direction of travel.

8 SAFETY SIGNS FOR THE USER OF ESCALATORS AND MOVING WALKS

The minimum diameter of the signs shall be 80 mm.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
2062 : 2011	Hot rolled medium and high tensile structural steel — Specification (*seventh revision*)
732 : 2019	Code of practice for electrical wiring installations (*fourth revision*)
4591 (Part 1/ Sec 2) : 2020	Escalators and moving walks: Part 1/Section 2 Guide for planning and selection (*first revision*)
4591 (Part 1/ Sec 3) : 2020	Escalators and moving walks: Part 1/Section 3 Inspection and Test (*first revision*)
5517 : 1993	Steels for hardening and tempering — Specification (*second revision*)
3930 : 1994	Flame and induction hardening steels — Specification (*second revision*)
14700 (Part 6/ Sec 3) : 2018	Electromagnetic compatibility (EMC): Part 6 Generic standards, Section 3 Emission standards for residential, commercial and light-industrial environments (*first revision*)
14700 (Part 4/ Sec 1) : 2019	Electromagnetic compatibility (EMC): Part 4 Testing and measurement techniques, Section 1 Overview of IEC 61000-4 series (*second revision*)
12777 : 1989	Method for classification of flame spread of products
3043 : 2018	Code of practice for earthing (*second revision*)
IS/IEC 60529 : 2001	Degrees of protection provided by enclosures (IP CODE)
IS/IEC 60947-4-1 : 2012	Low voltage switchgear and control gear: Part 4 Contactors and motor-starters, Section 1 Electromechanical contactors and motor-starters (*first revision*)
IS/IEC 60947-5-1 : 2009	Low voltage switchgear and control gear: Part 5 Control circuit devices and switching elements, Section 1 Electromechanical control circuit devices (*first revision*)
2026 (Part 1) : 2011	Power transformers: Part 1 General (*second revision*)
694 : 2010	Polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750 V (*fourth revision*)
9409 : 1980	Classification of electrical and electronic equipment with regard to protection against electric shock
	The Electricity Act, 2003 and Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010
	The Electricity Act, 2003 and Central Electricity Authority Regulations, 2010
SP 6 (Part 6) : 1972	Handbook for structural engineers: Part 6 Application of plastic theory in design of steel structures

ANNEX B

(*Informative*)

(*Clause* 2)

IS No.	*Title*
9000 (Part 8) : 1981	Basic environmental testing procedures for electronic and electrical items: Part 8 Vibration (sinusoidal) test
9000 (Part 14/Sec 1 to 3) : 1988	Basic environmental testing procedures for electronic and electrical items: Part 14 Test N: Change of temperature (*first revision*)
9001 (Part 17/Sec 1) : 1985	Guidance for environmental testing: Part 17 Impact test, Section 1 Shock test
9001 (Part 17/Sec 2) : 1985	Guidance for environmental testing: Part 17 Impact test, Section 2 Bump test
IS/IEC 60269-1 : 2014	Low-voltage fuses: Part 1 General requirements
15382 (Part 1) : 2014	Insulation coordination for equipment within low-voltage systems: Part 1 Principles, requirements and tests (*first revision*)
7098 (Part 1) : 1998	Specification for crosslinked polyethylene insulated PVC sheathed cables: Part 1 For working voltages up to and including 1 100 volts (*first revision*)
14901 (Part 5) : 2004	Semiconductor devices — Discrete devices and integrated circuits: Part 5 Optoelectronic devices

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Lift and Escalators Sectional Committee, ETD 25

Organization	*Representative(s)*
Central Public Works Department (CPWD), New Delhi	Shri C. K. Varma (***Chairman***)
Chief Electrical Inspector, Maharashtra	Shri S. R. Bagde
Chief Electrical Inspectorate, Tamil Nadu	Shri T. Al. Tenappan Shri D. Karthikeyan (*Alternate*)
Chief Electrical Inspectorate, Maharashtra	Shri N. G. Behram Shri V. H. Shahare (*Alternate* I) Shri D. M. Nikhate (*Alternate* II)
Chief Electrical Inspectorate, Energy & Petrochemical Department Government of Gujarat	Shri Haiderali H. Khoja Shri Ashwin B. Chaudhary (*Alternate* I) Shri Gopal K. Prajapati (*Alternate* II)
Electrical Inspectorate, Labour Deptt, Govt of NCT of Delhi	Shri Mukesh Kumar Sharma Shri Jogender Singh (*Alternate*)
Delhi Metro Rail Corporation Limited	Shri Manuj Singhal Shri Manjeet Kumar (*Alternate* I) Shri Sumit Kumar Sharma (*Alternate* II)
Maharashtra Industrial Development Corporation (MIDC) Fire Service	Shri Santosh S. Warick
Electrical Contractors Association of Maharashtra	Shri Anil Gachke
Fujitec India Pvt. Ltd, Tamil Nadu	Shri S. P. Rao Shri R. Rajesh (*Alternate* I) Shri Arunsankar M. S. (*Alternate* II)
Johnson Lifts Pvt Limited, Chennai	Shri T. Subramanian Shri V. Karthikeyan (*Alternate*)
Kone Elevator India Private Limited, Chennai	Shri Tipnis P. M. Shri P. Gurumoorthy (*Alternate* I) Shri U. Viswanathan (*Alternate* II)
Lerch Bates Private Limited, Mumbai	Shri Sumeet Majumdar Shri Prashant Kulkarni (*Alternate*)
Otis Elevator Company (India) Limited, Mumbai	Shri Vijay Jaychandran Shri Abhijit Dandekar (*Alternate* I) Shri H. N. Prashanth (*Alternate* II)
Schindler India Pvt Ltd, Mumbai	Shri Nimish Deshpande Shri Ronnie Dante (*Alternate* I) Shri Nitin Kadam (*Alternate* II)
Tak Consulting Private Limited, Mumbai	Shri Tak Mathews Shri William Rebello (*Alternate*)
Thyssenkrupp Elevator India Pvt Ltd., Mumbai	Shri Vishnu Parashar Shri Rajesh Joshi (*Alternate*)
Bis Directorate General	Shri Rajeev Sharma, Scientist 'F' and Head (ETD) [Representing Director General (*Ex-officio*)]

Member Secretary

Ms Meghna Mudgal
Scientist 'C' (ETD), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of ‘BIS Catalogue’ and ‘Standards: Monthly Additions’.

This Indian Standard has been developed from Doc No.: ETD 25 (11981).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg CHANDIGARH 160019	265 0206 265 0290
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	2254 1216, 2254 1442 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	2832 9295, 2832 7858 2832 7891, 2832 7892

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. DURGAPUR. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. JAMMU. JAMSHEDPUR. KOCHI. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAIPUR. RAJKOT. VISAKHAPATNAM.

Published by BIS, New Delhi